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MINERAL COMMODITY SUMMARIES 1986

COMPLETED

BUREAU OF MINES
(With resource information by the GEOLOGICAL SURVEY)
UNITED STATES DEPARTMENT OF THE INTERIOR

MINERAL COMMODITY SUMMARIES

1986

AN UP-TO-DATE SUMMARY OF 87
NONFUEL MINERAL COMMODITIES

This report is the earliest Government publication to furnish estimates covering 1985 nonfuel mineral industry data. Most of the estimates are based on 9 months data. These data sheets contain information on the domestic industry structure, Government programs, tariffs, and 5-year salient statistics for 87 individual minerals and metals. World resource data appearing in the statements have been provided by the Geological Survey.

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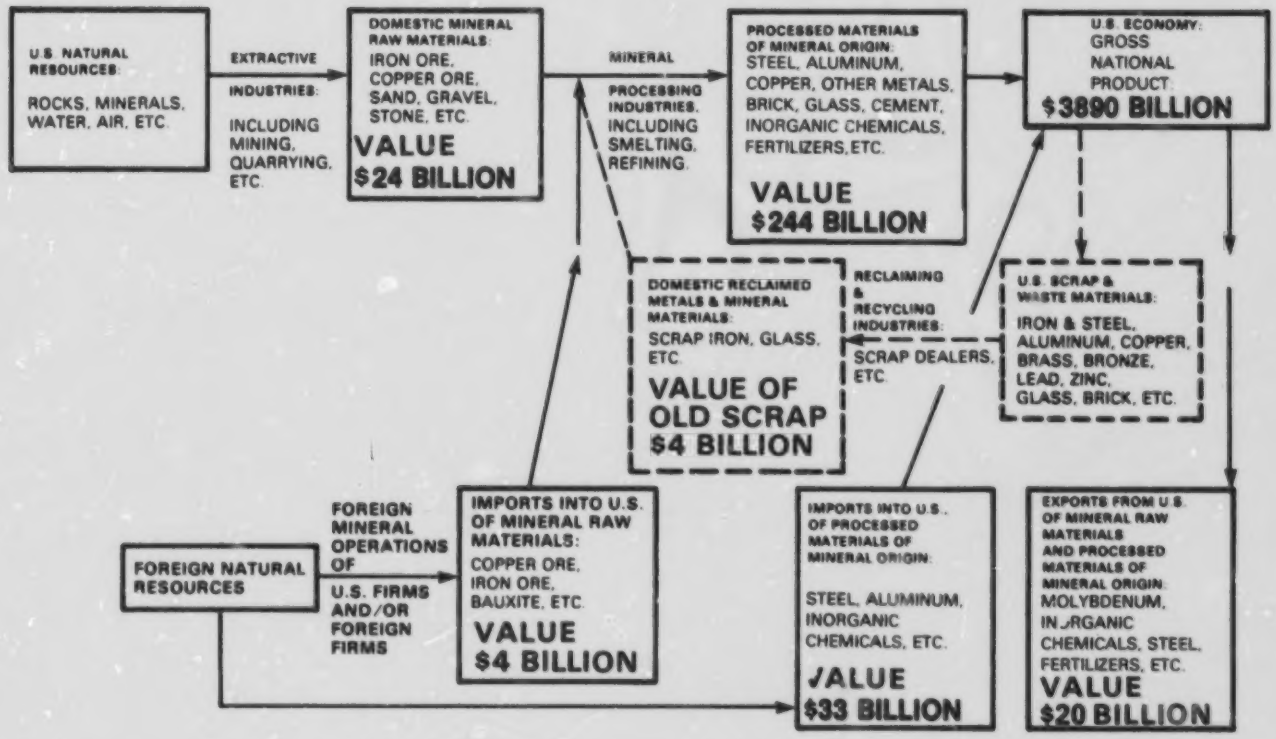
THE ROLE OF NONFUEL MINERALS IN THE U.S. ECONOMY

(ESTIMATED VALUES FOR 1985)*


U.S. NATURAL RESOURCES:
ROCKS, MINERALS, WATER, AIR, ETC.
EXTRACTIVE INDUSTRIES:
INCLUDING MINING, QUARRYING, ETC.
DOMESTIC MINERAL RAW MATERIALS:
IRON ORE, COPPER ORE, SAND, GRAVEL, STONE, ETC.
VALUE $24 BILLION
MINERAL PROCESSING INDUSTRIES, INCLUDING SMELTING, REFINING.
PROCESSED MATERIALS OF MINERAL ORIGIN:
STEEL, ALUMINUM, COPPER, OTHER METALS, BRICK, GLASS, CEMENT, INORGANIC CHEMICALS, FERTILIZERS, ETC.
VALUE $244 BILLION
U.S. ECONOMY:
GROSS NATIONAL PRODUCT
$3890 BILLION
DOMESTIC RECLAIMED METALS & MINERAL MATERIALS:
SCRAP IRON, GLASS, ETC.
VALUE OF OLD SCRAP $4 BILLION
RECLAIMING & RECYCLING INDUSTRIES:
SCRAP DEALERS, ETC.
U.S. SCRAP & WASTE MATERIALS:
IRON & STEEL, ALUMINUM, COPPER, BRASS, BRONZE, LEAD, ZINC, GLASS, BRICK, ETC.
FOREIGN NATURAL RESOURCES
FOREIGN MINERAL OPERATIONS OF U.S. FIRMS AND/OR FOREIGN FIRMS
IMPORTS INTO U.S. OF MINERAL RAW MATERIALS:
COPPER ORE, IRON ORE, BAUXITE, ETC.
VALUE $4 BILLION
IMPORTS INTO U.S. OF PROCESSED MATERIALS OF MINERAL ORIGIN:
STEEL, ALUMINUM, INORGANIC CHEMICALS, ETC.
VALUE $33 BILLION
EXPORTS FROM U.S. OF MINERAL RAW MATERIALS AND PROCESSED MATERIALS OF MINERAL ORIGIN:
MOLYBDENUM, INORGANIC CHEMICALS, STEEL, FERTILIZERS, ETC.
VALUE $20 BILLION

* DECEMBER 12, 1985-Based on statistics for first 10 months of 1985 only.

BUREAU OF MINES, U.S. DEPARTMENT OF THE INTERIOR
(based in part on U.S. Department of Commerce data)

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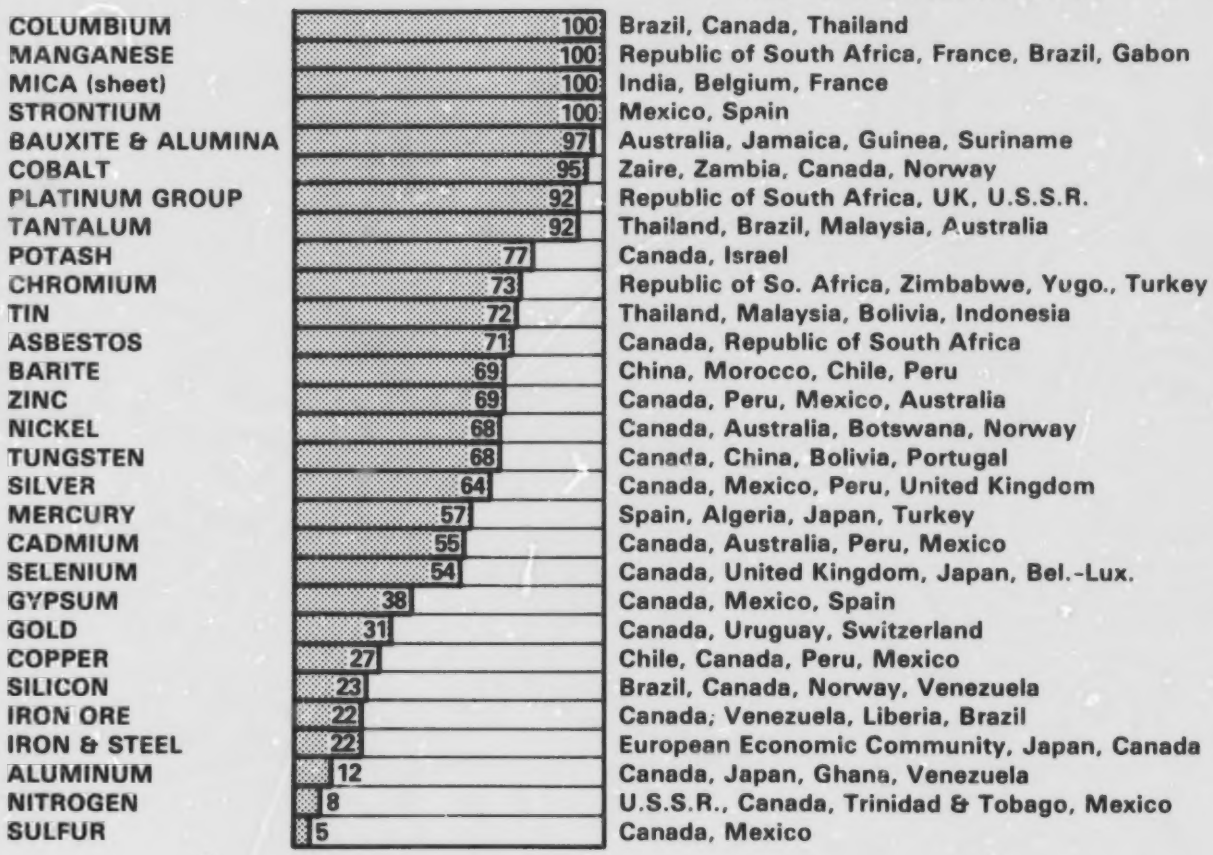
1985 NET IMPORT RELIANCE e/1/ OF SELECTED NONFUEL MINERAL MATERIALS AS A PERCENT OF APPARENT CONSUMPTION2/

U.S.A.


MAJOR SOURCES (1981-84)
COLUMBIUM 100 Brazil, Canada, Thailand
MANGANESE 100 Republic of South Africa, France, Brazil, Gabon
MICA (sheet) 100 India, Belgium, France
STRONTIUM 100 Mexico, Spain
BAUXITE & ALUMINA 97 Australia, Jamaica, Guinea, Suriname
COBALT 95 Zaire, Zambia, Canada, Norway
PLATINUM GROUP 92 Republic of South Africa, UK, U.S.S.R.
TANTALUM 92 Thailand, Brazil, Malaysia, Australia
POTASH 77 Canada, Israel
CHROMIUM 73 Republic of So. Africa, Zimbabwe, Yugo., Turkey
TIN 72 Thailand, Malaysia, Bolivia, Indonesia
ASBESTOS 71 Canada, Republic of South Africa
BARITE 69 China, Morocco, Chile, Peru
ZINC 69 Canada, Peru, Mexico, Australia
NICKEL 68 Canada, Australia, Botswana, Norway
TUNGSTEN 68 Canada, China, Bolivia, Portugal
SILVER 64 Canada, Mexico, Peru, United Kingdom
MERCURY 57 Spain, Algeria, Japan, Turkey
CADMIUM 55 Canada, Australia, Peru, Mexico
SELENIUM 54 Canada, United Kingdom, Japan, Bel.-Lux.
GYPSUM 38 Canada, Mexico, Spain
GOLD 31 Canada, Uruguay, Switzerland
COPPER 27 Chile, Canada, Peru, Mexico
SILICON 23 Brazil, Canada, Norway, Venezuela
IRON ORE 22 Canada, Venezuela, Liberia, Brazil
IRON & STEEL 22 European Economic Community, Japan, Canada
ALUMINUM 12 Canada, Japan, Ghana, Venezuela
NITROGEN 8 U.S.S.R., Canada, Trinidad & Tobago, Mexico
SULFUR 5 Canada, Mexico

e/ Estimated.

1/ Net import reliance = imports − exports + adjustments for Government and industry stock changes.

2/ Apparent consumption = U.S. primary + secondary production + net import reliance.

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The value of domestic raw nonfuel mineral output in 1985 was estimated at $23.7 billion, 2% above the 1984 value of $23.1 billion. This crude mineral output was the basis for approximately $244 billion worth of processed materials of mineral origin.

Value of Raw Nonfuel Mineral Production in the United States
(Million dollars)

	1983	1984	1985
Metals	5,837	5,977	5,633
Nonmetals 1/	15,263	17,173	18,085
Total	21,110	23,150	23,718

A U.S. company permanently closed its alumina plant in St. Croix, U.S. Virgin Islands, reducing domestic alumina capacity by 10%. Another U.S. company sold its 26% interest in an alumina plant in Jamaica to its two U.S. partners. On completion of the purchase agreement, the two remaining partners promptly closed the plant for an indefinite period, citing a world oversupply of alumina and unacceptably low prices.

Domestic production of primary aluminum, recovery of aluminum from old scrap, and imports of aluminum metal and scrap decreased. As producers cut back on production, industry stocks decreased slowly while exports increased. U.S. aluminum demand for packaging remained constant but demand in transportation equipment, building, and consumer durables slowed, and overall consumption of aluminum fell. A company based in Canada and another in Australia entered the U.S. aluminum market with purchase of primary aluminum smelters at Sebree, KY, and Goldendale, WA, respectively. World inventories of metal remained high throughout the year causing world prices to remain depressed.

The General Services Administration (GSA) completed the authorized sale from the National Defense Stockpile of excess antimony metal. Any future sales of antimony by GSA will require additional legislative authority.

U.S. production of barite increased to 890,000 short tons valued at $25 million, 15% higher than the 1984 quantity but 22% lower in value. Consumption of crushed and ground barite was 2.4 million tons, under the 2.9 million tons in 1984. Imports for consumption of less expensive crude barite rose to 2.0 million tons, after a decline in 1983, to just under the record high of 1982, 2.3 million tons. Ground Chinese and Moroccan drilling-mud-grade-barite imports, previously nil, competed with domestically ground barite in the depressed gulf coast area markets.

The only domestic colemanite producer, one of three U.S. producers of boron minerals and compounds, announced plans to temporarily cease mining operations early in 1986.

A major bromine producer announced plans to discontinue production at a Michigan plant in 1986. Demand for bromine as a lead scavenger in leaded gasoline continued decreasing with the implementation of new Federal regulations to reduce the permissible amount of lead in gasoline. A 1985 law to authorize a U.S.-Israeli free-trade agreement raised the issue of potential harm to the U.S. bromine industry by increased competition from Israeli imports.

In April, company officials announced the closure of a zinc refinery and cadmium plant in Corpus Christi, TX, for an indefinite period of time, decreasing to four the number of domestic plants which recover cadmium.

Domestic production of portland, masonry, and other cement, 80 million short tons, was 3% more than that of 1984. Apparent consumption increased 7%, from 84 to 90 million tons. Cement consumption increased in all except the East South Central Region of the country. Imports of hydraulic cement and clinker reached a record level, 14 million tons, accounting for 15% of U.S. consumption.

Combined output of all types of clay was 46 million short tons valued at a record high of $1.1 billion.

Domestic apparent consumption of cobalt was estimated at 7,500 short tons, down from 8,948 tons in 1984. The world market was characterized by large producer inventories. The spot price for cathode cobalt remained stable throughout the year at about $11.50 per pound.

U.S. demand for columbium remained virtually unchanged, whereas demand for tantalum was down significantly. There was no domestic mine production of either columbium or tantalum. Reported consumption of columbium in superalloys continued to advance, that portion used in the form of nickel columbium increasing substantially. Imports of both columbium concentrates and ferrocolumbium were down from the 1984 levels. Prices were stable for columbium concentrates and columbium products. Estimated sales of tantalum capacitors were down by over 20%, reflecting a downturn in the electronics industry. Imports of tantalum concentrates declined an estimated 60%. The spot

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price for tantalum concentrates was being quoted in the fourth quarter at around $22 per pound of contained tantalum pentoxide, the lowest level since first quarter 1983.

Domestic copper smelter and refinery production dropped significantly. The U.S. industry continued to retrench, regroup, and cut costs in response to the continued poor market for copper. Several mines and processing plants closed, while others reopened or were expanding as changes in ownership continued. The new ownership included some acquisitions by foreign firms and employee-based partnerships. U.S. import reliance for refined copper at 27% of apparent consumption was a record high, while exports of scrap and concentrates were increasing. The strength of the dollar and high costs of labor and environmental compliance continued to impact the domestic industry. World and U.S. refined copper inventories decreased rapidly through May 1985 but, by yearend, London Metal Exchange stocks were back up to higher, 1984 levels. U.S. refined inventories, on the other hand, decreased by about 246,000 metric tons.

Domestic production of ferroalloys was down by about 10% overall compared with that of 1984. Demand for ferroalloys was down by a comparable amount, the result of reduced production by major consuming industries. Operating rates for producers of the bulk ferroalloys of chromium, manganese, and silicon, and their respective metals averaged about 40% of capacity, down slightly from that of 1984. Demand for all bulk ferroalloys declined, silicon by a smaller percentage than that for chromium or manganese. Total exports declined by a greater percentage than total imports. Exports were small compared with imports. Availability of low-priced imports and the strength of the U.S. dollar helped foreign producers increase their share of the domestic ferroalloy market. Continuing the trend in the United States of eliminating unprofitable ferroalloy operations, one company announced that it would close its Graham, WV, plant on December 31. Government actions impacting ferroalloy producers that were initiated or proposed included GSA's announcement that the stockpile upgrading program would be continued for the third consecutive year and introduction of legislation designed to preserve an adequate level of domestic ferroalloy capacity.

Fluorspar production and demand were near 1984 levels, with consumption by steelmakers decreasing and that by the chemical industry increasing. Imports decreased 13% to about 610,000 tons.

The only operation in the world where gallium or germanium was recovered as a principal product began production late in the year. The plant, in St. George, UT, was expected to have an annual production capacity of 10,000 kilograms of crude gallium metal and 17,900 kilograms of crude germanium dioxide (germanium content).

Despite the relatively low price for gold, the domestic gold mining industry continued to expand during the year and production reached the highest level since 1950.

Domestic output of crude gypsum increased to 14.4 million short tons, slightly more than that of 1984. Total value increased to $120 million. Imports of gypsum rock increased 4% compared with those of 1984, with Canada supplying 64%, Mexico 21%, and Spain 14%. Shipments of prefabricated gypsum products, principally wallboard, were up 4% over those of 1984 and established a new annual record. Sales of gypsum for use in cement were 4.1 million tons, for agriculture 1.3 million tons, and for industrial and building plaster 770,000 tons.

One of the three producers of crude iodine announced plans to discontinue production in Michigan at yearend 1986.

U.S. mine production and shipments of iron ore products were about 6% less than in 1984, as steel imports remained high and fewer blast furnaces were operated. Mine shipments were estimated at 48.5 million long tons valued at $2.1 billion, of which pellets made up about 95%. As in 1984, most of the principal mines and pelletizing plants were closed for periods of 1 to 4 months, and several in Minnesota were scheduled to close by December for an indefinite period. One pellet production facility was idle all year, and another was permanently closed on June 28. The closure reduced installed U.S. production capacity for pellets by 2.7 million tons to about 80 million tons per year and effective capacity to about 60 million tons per year. For the first time, published prices for Lake Superior pellets were reduced by some producers during the summer; the reductions amounted to 12% or more, and were believed to result from declining costs of production as well as from competition by U.S. and foreign producers. Published lake freight rates were unchanged.

Production and shipments of iron and steel were little changed compared with those in 1984, despite a small decrease in imports. The industry continued to operate below 70% of capability for most of the year, and most steel companies continued to lose money on their steel operations. The seventh largest producer filed for bankruptcy and attempted to reorganize. The industry tried to reduce costs by closing inefficient or underutilized facilities and by reducing employment costs. Imports of steel decreased slightly after 5-year export restraint agreements were negotiated with

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most major exporting countries. Negotiations with the European Economic Community extended and expanded an earlier agreement.

Although U.S. mine production of lead increased substantially, output was the second lowest since 1968. A sharp drop in domestic demand was attributed to overstocking of metal by battery manufacturers in the last quarter of 1984, a relatively mild winter, plus a 50% reduction in the allowable use of lead for gasoline additives, which became effective July 1. Secondary production was lower, and five smelter-refineries with capacities totaling 200,000 tons per year were closed indefinitely, making about 550,000 tons shut down since 1979. One of the Nation's five primary lead smelters was also closed.

Domestic primary magnesium metal producers operated at about 80% of capacity, in response to continued strong demand, especially in the automotive sector where domestic automobile manufacturers were reportedly replacing some aluminum components with magnesium. Import dependence for magnesium compounds has trended sharply upward over the past 3 years, reaching a record high in 1985. The increased reliance on imports was apparently due to the strength of the U.S. dollar.

Domestic production of sheet mica was negligible. Demand was met by imports and shipments from Government stockpile excesses. India continued to be the major source of imports. Consumption, 2.4 million pounds, was valued at $2.6 million, about the same quantity and value as in 1984, primarily in the manufacture of electrical and electronic equipment. Domestic production of scrap and flake mica, excluding low-quality sericite, was about 13% lower than in 1984, and the value was about $6 million. The bulk of domestic production was ground for use in joint cement, paint, roofing, oil-well drilling, and rubber products. Ground mica sales were valued at $19 million, a decrease of 12% from 1984.

Mine production of molybdenum was estimated at 107 million pounds, valued at $337 million, compared with production of 104 million pounds, valued at $370 million in 1984. Apparent consumption was estimated to have decreased 25% to 31 million pounds, while exports increased from 76 million pounds in 1984 to 78 million pounds. Stocks rose from 38 million pounds in 1984 to an estimated 45 million pounds. The average value of a pound of molybdenum was about $3.15.

Domestic primary nickel consumption fell 10%. Lower consumption in stainless steel and nickel-base alloys led the decline. Imports slowed accordingly while consumer stocks changed little from 1984 amounts. A continuing worldwide over-abundance of nickel production capacity kept nickel prices considerably below those required to prompt development of domestic deposits, which contain a comparatively low concentration of nickel.

Phosphate rock producers and manufacturers of phosphate fertilizer had a difficult year. Without the export market, which had declined considerably, producers' finances would have been in even worse condition. Excess capacity in mines and chemical plants caused several companies to file for Chapter 11 of the Federal Bankruptcy Act; some sold their reserves, others temporarily closed mines and chemical plants, and some closed plants indefinitely.

Worldwide overcapacity relative to decelerating demand growth over the past 2 years has pushed the market price for potash down to unprofitable levels for most U.S. producers and led to employment dislocations. One mine was closed temporarily in 1985 and two mines and mills were sold. From a domestic production peak of 3.3 million metric tons in 1966, potash had declined to 2.2 million tons by 1980, and to 1.3 million tons in 1985.

The major salt consumer, the chlorine-caustic soda industry, experienced excess capacity and slow growth in demand for chloralkali-based products, resulting in the closure of two plants with captive salt brine operations in Michigan and West Virginia. In addition, a solar salt facility in Utah was sold because of production problems arising from flooded evaporation ponds. The U.S. Department of Commerce, in a preliminary finding, determined that Canadian rock salt was, or was likely to be, sold at less than fair value in the United States.

Construction sand and gravel sold or used was about 800 million short tons valued at about $2.4 billion, an increase of about 4% in tonnage and 9% in value. California, Texas, Michigan, Arizona, and Ohio were the largest producing States. Industrial sand and gravel sold or used totaled about 30 million tons valued at $390 million, an increase of 2% in tonnage and 3% in value. The five leading producing States were Illinois, Michigan, New Jersey, California, and Texas.

The average silver price was $6.20 per troy ounce, nearly $2.00 per ounce lower than that of 1984 with the decline primarily attributed to weak oil prices, continued high value of the U.S. dollar in terms of other currencies, and sales of silver by private investors. Industrial consumption was essentially unchanged from that of 1984, possibly reflecting changing consumer tastes along with the more efficient use of silver in various end uses such as photography.

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Apparent consumption of soda ash decreased for the third consecutive year, primarily because of increased use of cullet and competition from plastic bottles that adversely affected glass containers, the largest end use of soda ash. However, the export association composed of all six U.S. producers set a record high for exports of 1.8 million short tons, an increase of 71% since 1981.

Apparent consumption of sodium sulfate was at the lowest level in more than 30 years. Despite the recent economic recovery in the U.S. pulp and paper industry, demand for low-purity sodium sulfate, known as salt cake, continued to decline, primarily because of substituted chemicals. Although demand for high-grade sodium sulfate was weak, it had doubled since the mid-1970's. A byproduct sodium sulfate plant in Maryland closed permanently.

Crushed stone output increased to 1 billion short tons valued at about $4.2 billion, from 956 million tons valued at $3.8 billion in 1984. The five leading producing States were Texas, Florida, Pennsylvania, Virginia, and Georgia. Domestic dimension stone output was 1.30 million tons, a slight increase over the 1.16 million tons in 1984. Value increased to $170 million from $155 million in 1984. Imports increased significantly for the fourth successive year and, in 1985, accounted for 67%, by value, of U.S. consumption. Italy supplied 69% of these imports.

Declining demand for manufactured fertilizers resulted in a 5% decrease in U.S. sulfur demand to 12 million metric tons. Sulfur shipped for domestic consumption was obtained mainly from domestic sources. With the continued imbalance of world sulfur demand over production, world stocks decreased by about 2 million tons, although world sulfur output increased by over 2 million tons.

In late October, the International Tin Council (ITC), of which the United States is not a member, exhausted available funds to buy tin to support the price. As a result, tin trading was suspended on the London Metal Exchange and GSA halted its tin sales, pending resolution of the crisis; both cessations remained in effect through the end of November. A consortium of 16 major banks offered a financial package to the ITC but member countries had not reached agreement on the package by late November.

Domestic mine production of ilmenite and rutile increased significantly. Production and consumption of titanium dioxide (TiO_2) pigments reached new peaks, and prices of titanium concentrates and TiO_2 pigments increased. A TiO_2 producer based in Finland purchased a TiO_2 pigment production facility in Savannah, GA. A decrease of 11% in titanium sponge metal consumption resulted mainly from leveling off of orders for commercial and military aircraft, and lower than expected requirements for other industrial uses. The inventory of titanium sponge in the National Defense Stockpile reached 19% of the goal on completion of delivery of 4,500 tons of sponge under contracts awarded by GSA in October 1983.

Domestic mine production of tungsten totaled about 1,100 metric tons, valued at about $8 million, a decrease of 6% in volume and 40% in value from 1984 levels. Apparent tungsten consumption was approximately 8,500 tons, a decrease of 16% from 10,164 tons in 1984. Tungsten concentrate imports contained 4,800 tons of tungsten, a decrease of 17% from the 5,807 tons imported in 1984. The average monthly price of tungsten concentrate per metric ton unit of WO_3 was $75 in January, $77 in April, and $68 in October.

For the first time since 1907, no vanadium was recovered from the uraniferous sandstones of the Colorado Plateau. All five uranium mills in Colorado and Utah that had coproduct vanadium recovery circuits were on standby because of the continuing depressed price for yellowcake and increased imports of uranium, both natural and enriched. Increased recovery of vanadium from petroleum residues, utility ash, and spent catalysts partially compensated for the drop in domestic mine production. The strong dollar encouraged near-record imports of ferrovanadium from Canada and Europe. Apparent U.S. consumption of vanadium was estimated to be 10.6 million pounds, about 60% higher than the 20-year low of 6.6 million pounds in 1983.

Domestic mine output of zinc fell to its lowest level since 1921 owing to strikes at mines in Tennessee and New York. The value of mine production, based on the average metal price, fell about $70 million, to $200 million. Slab zinc production declined owing mainly to the April closure of a primary zinc smelter in Texas.

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The White House announced on July 8, 1985, that the President had approved National Security Council (NSC) recommendations for modernizing the strategic and critical materials stockpile. Under the NSC proposal, the stockpile would be structured into two tiers. Tier I would contain materials required by military, industrial, and essential civilian users during a military conflict and that would not be available from domestic or reliable foreign sources. Tier II would contain a supplemental reserve of materials already possessed by the Government. The updated program provides for a Tier I stockpile of materials with Goals valued at $700 million and a Tier II Supplemental Reserve of materials valued at $6.0 billion, based on market prices of May 31, 1985. The proposal is now before Congress, where the basis for the new stockpile goals will be examined. All of the materials recommended for stockpiling in Tiers I and II--with the sole exception of natural rubber (for aircraft tires)--are mineral materials under the primary jurisdiction of the Department of the Interior pursuant to Executive Order 12155 under the Stock Piling Act and Executive Orders 10480 and 11490 under the Defense Production Act. In proposing the new stockpile goals, the NSC emphasized the need for studies to identify new high-technology materials that may be required for future weapons systems. The Bureau of Mines is working with the Department of Defense and other agencies in these studies.

Tier I - Stockpile Goals
(Millions of dollars,
Goal value based on 5/31/85 market prices)

Commodity	Goal	Quantity
Antimony	$12.6	4,585 st
Bauxite		
Bauxite, refractory-grade		
Bauxite, abrasive-grade		
Beryllium concentrate		
Bismuth		
Cadmium		
Chromium	84.9	199,300 st
Cobalt	245.0	22,570,000 lb
Columbium		
Copper		
Diamond, industrial stones		
Fluorspar		
Germanium	154.8	146,049.4 kg
Graphite, Ceylon	9.9	5,058.5 st
Graphite, Malagasy	42.0	13,995.9 st
Graphite, other	1.6	2,237.1 st
Iodine		
Lead		
Manganese		
Mercury (mine)		
Mica, muscovite block	1.3	246,400 lb
Mica, muscovite film	.2	18,700 lb
Mica, muscovite split	21.6	14,391,100 lb
Mica, phlogopite block	.5	85,000 lb
Mica, phlogopite split	1.0	482,600 lb
Molybdenum		
Nickel		
Platinum group, iridium		
Platinum group, palladium		
Platinum group, platinum		
Quartz crystal, natural	.2	26,500 lb
Rubber		
Rutile		
Silicon carbide		
Silver		
Tantalum	72.1	1,900,700 lb
Tin		
Titanium	43.3	3,900 st
Tungsten		
Vanadium		
Zinc		
	$691.0	

Tier II - Supplemental Reserve
(Millions of dollars,
Value based on 5/31/85 market prices)

Commodity	Value	Quantity
Aluminum oxide, abrasive grain group	$ 65	208,139 st ab.grain eq
Bauxite	828	4,278,912 st Al met eq
Bauxite, refractory-grade	52	274,926 lct
Beryllium	164	437 st Be met eq
Chromite, refractory-grade	18	180,000 sdt
Chromium	756	594,123 st Cr met eq
Cobalt	65	6,000,000 lb
Columbium	19	2,532,419 lb Cb met eq
Copper	46	29,048 st
Diamond, industrial stones	205	7,950,000 kt
Graphite, Ceylon	1	415 st
Iodine	31	5,500,000 lb
Lead	123	300,000 st
Manganese	369	869,667 st Mn met eq
Mica, muscovite block	1	200,000 lb
Nickel, electrolytic	24	5,000 st
Quartz crystal	11	1,800,000 lb
Rubber	116	127,455 mt
Silver	543	87,500,000 oz
Tantalum	84	1,023,320 lb Ta met eq
Tin	1,814	150,000 mt
Titanium	233	21,100 st
Tungsten	298	52,215,245 lb W met eq
Vanadium	8	722 st V metal
Zinc	81	85,000 st
	$5,955	

Abbreviations

kt	-	carat
lb Cb met eq	-	pounds of columbium metal equivalent
lb Ta met eq	-	pounds of tantalum metal equivalent
lb W met eq	-	pounds of tungsten metal equivalent
lct	-	long calcined ton
mt	-	metric ton
oz	-	troy ounce
sdt	-	short dry ton
st ab.grain eq	-	short tons of abrasive grain equivalent
st Al met eq	-	short tons of aluminum metal equivalent
st Be met eq	-	short tons beryllium metal equivalent
st Cr met eq	-	short tons of chromium metal equivalent
st Mn met eq	-	short tons manganese metal equivalent
st V metal	-	short tons of vanadium metal

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ALUMINUM 1/

(Data in thousand metric tons of metal, unless noted)

1. Domestic Production and Use: In 1985, 11 companies operated 26 primary aluminum reduction plants, with 3 firms accounting for 64% of production. Washington, Oregon, and Montana accounted for 35% of the production; Indiana, Kentucky, Missouri, and Tennessee 25%; Alabama, Arkansas, Texas, South Carolina, and North Carolina 17%; other States 23%. Based on published producer prices, output of primary metal in 1985 was valued at $6.2 billion. Aluminum consumption by 25,000 firms was centered in the east-central United States. Packaging accounted for an estimated 38% of domestic consumption in 1985, transportation, 21%; building, 16%; electrical, 8%; consumer durables, 7%; and other uses, 10%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Primary	4,489	3,274	3,353	4,099	3,460
Secondary (from old scrap)	758	782	820	825	820
Imports for consumption	848	878	1,091	1,477	1,400
Exports	787	748	776	734	980
Consumption, apparent 2/	4,614	4,370	5,035	5,279	4,883
Price, ingot, average, cents per pound:					
U.S. producer list	76.0	76.0	77.8	81.0	81.0
U.S. market (spot)	59.8	46.8	68.3	61.1	46.0
Stocks, aluminum industry, yearend	2,996	2,812	2,265	2,653	2,470
Employment: Primary reduction e/	21,000	19,000	21,000	20,000	19,000
Secondary smelter e/	4,000	4,000	4,000	3,800	3,800
Net import reliance 3/ as a percent of apparent consumption	4/E	7	17	7	12

3. Recycling: Aluminum recovery from scrap generated from current operations (new scrap) accounted for about 53% of the total recovery from purchased scrap. Discarded aluminum products (old scrap) such as cans accounted for the remainder. Aluminum recovery from old scrap estimated at 820,000 tons in 1985 was about 17% of apparent consumption.

4. Import Sources (1981-84): Canada 58%, Japan 8%, Ghana 7%, Venezuela 4%, Other 23%.

5. Tariff: In 1985, TSUS numbers 618.02 and 618.25 imported from Ghana and Venezuela had a special free tariff rate.

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Unwrought (in coils)	618.01	2.7% ad val.	2.6% ad val.	18.5% ad val.
Unwrought (other than aluminum silicon alloys)	618.02	0.1¢/lb	Free	11.0% ad val.
Wrought (bars, plates, sheets, strip)	618.25	3.0% ad val.	3.0% ad val.	13.5% ad val.

6. Depletion Allowance: None. 1/

7. Government Stockpile:

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Aluminum	635	2	-	-

e/ Estimated. E Net exporter.
1/ See also Bauxite.
2/ Domestic primary metal production plus recovery from old aluminum scrap and net import reliance.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ Increase in industry stocks exceeded net imports.

Prepared by F. X. McCawley, telephone number (202) 634-1080 and Ruth Hough (202) 634-1101.

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8. Events, Trends, and Issues: U.S. production of primary aluminum in 1985 decreased from that of 1984 as aluminum producers shut down potlines due to high inventories throughout the world, the low price of ingot metal and high operating costs. Imports of ingot, scrap and other forms were estimated at 1.4 million tons, a decrease of about 5% from those of 1984. Exports increased to 980,000 tons, but the United States remained a net importer of aluminum. Metallic recovery from old scrap decreased slightly, but recycling of used beverage cans remained high. Total apparent aluminum consumption fell about 8% from that of 1984 as the 1983-84 economic recovery leveled off and consumers lowered inventories. Some producers discontinued a list price, but the published producers list price, as quoted by Metals Week, remained at 81 cents per pound throughout October. In January, spot prices were about 50 cents. By mid-May, prices climbed to 52.5 cents before declining to 45.5 cents in October. Prices on the COMEX and LME followed the trend of spot prices.

U.S. primary producers began 1985 with about 78% of the 4.9 million tons of annual capacity in operation. By yearend, the operating rate was down to about 63%. Of the 29 U.S. aluminum reduction plants, excluding the Palestine, TX, experimental plant, 7 were closed by yearend, 4 were operating at full capacity and 18 were partially operating. The Bonneville Power Administration continued to offer power rate discounts to Pacific Northwest aluminum producers in 1985. The last offer, effective September 1, 1985, through June 30, 1986, reduced power rates to an average of 19.23 mills per kilowatt-hour. In Arkansas, the Jones Mills and Arkadelphia smelters closed in October reportedly because of increased power costs. A reduction plant in Massena, NY, closed one potline that operated with high cost power from a nuclear plant of the New York Power Authority. During the year, major aluminum producers in Australia and Canada purchased the Goldendale, WA, and Sebree, KY, aluminum reduction plants, respectively, from domestic corporations divesting metal operations. Private investors and employees purchased the Columbia Falls, MT, aluminum reduction plant in September.

It is estimated that in 1986 production of primary aluminum will be 3.1 million tons and apparent consumption will be 4.7 million tons. The United States is expected to be a net importer of aluminum metal. From a 1983 base, apparent demand for aluminum is expected to increase at an average annual rate of about 4.6% through 1990. High operating costs of domestic aluminum reduction plants is expected to preclude future expansions and lower rates of domestic production is expected. Demand will probably be supplied from increased imports and recovery of metal from scrap.

9. World Plant Production and Capacity:

	Production		Yearend Capacity	
	1984	1985 e/	1984	1985 e/
United States	4,099	3,460	4,893	4,890
Australia	758	850	812	860
Canada	1,228	1,250	1,234	1,290
Norway	761	760	794	790
Other Market Economy Countries	5,729	5,750	7,119	7,210
China e/	380	380	382	380
U.S.S.R. e/	2,100	2,100	2,490	2,550
Other Centrally Planned Economies e/	466	450	481	480
World Total	15,521	15,000	18,205	18,450

10. World Resources: Domestic aluminum requirements cannot be met by domestic bauxite resources. Potential domestic nonbauxitic aluminum resources are abundant and could meet domestic aluminum demand. However, no processes for using these resources have been proven competitive with bauxite. The world reserve base for bauxite is sufficient to meet world demand for metal beyond the year 2000. 1/

11. Substitutes: Copper can replace aluminum in electrical applications and magnesium, titanium and steel can be used instead of aluminum for structural and ground transportation uses. Composites, wood and steel may be used in place of aluminum for construction, and glass, plastics, paper, and steel may replace aluminum in packaging.

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ANTIMONY

(Data in short tons of antimony content, unless noted)

1. Domestic Production and Use: Primary antimony metal and oxide were produced by 9 companies operating 10 plants utilizing both foreign and domestic material. Three of these plants were located in Texas and one each in Idaho, Maryland, Montana, Nebraska, New Jersey, Ohio, and Tennessee. The estimated value of total primary production in 1985 was $52 million. Primary antimony was consumed at about 250 plants in States east of the Mississippi River, accounting for approximately 90% of reported primary consumption. The principal uses of primary antimony were flame retardants, 60%; transportation, including batteries, 10%; ceramics and glass, 10%; chemicals, 10%, and other, 10%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Mine--Silver-copper and stibnite ores	646	503	838	557	W
Lead ore	361	W	W	W	W
Refinery--Primary plants 1/	17,844	12,282	14,557	16,979	17,000
Secondary plants	19,856	16,596	14,204	14,806	13,000
Imports for consumption	17,970	13,387	12,885	23,089	20,000
Exports of metal, alloys, and oxide	776	1,107	669	991	1,200
Shipments from Govt. stockpile excesses	-	21	1,863	69	928
Consumption: Reported, primary antimony	11,592	9,414	10,418	12,447	13,000
Apparent 2/	35,205	30,922	29,712	33,232	W
Price, average, cents per pound 3/	135.5	107.2	91.3	151.2	130.0
Stocks, yearend	9,158	5,973	3,935	6,916	6,000
Employment, plant e/	130	130	130	130	130
Net import reliance 4/ as a percent of apparent consumption	47	50	54	58	W

3. Recycling: Approximately 11,500 tons of antimony was recovered from old scrap. Approximately 90% of the total secondary antimony was recovered as antimonial lead, most of which was consumed by the battery industry.

4. Import Sources (1981-84): Metal--China 48%, Bolivia 32%, Mexico 8%, Belgium-Luxembourg 6%, Other 6%.
Ores and concentrate--Bolivia 45%, Mexico 20%, Thailand 10%, Republic of South Africa 9%, Other 16%.
Oxide--Republic of South Africa 36%, China 22%, Bolivia 18%, France 13%, Other 11%.

5. Tariff: In 1985, antimony metal imported from Bolivia and Mexico was duty free.

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Ore	601.03	Free	Free	Free
Needle or liquated	603.10	0.1¢/lb.	0.1¢/lb.	0.25¢/lb.
Metal, unwrought	632.02	0.1¢/lb.	Free	2¢/lb.
Oxide	417.50	Free	Free	2¢/lb.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
1/ Includes antimony recovered from domestic and foreign ores.
2/ Domestic mine production + antimony recovered from old scrap + net import reliance. Antimony recovered from lead ores is excluded for the years 1982-85.
3/ New York dealer price for 99.5% to 99.6% metal, c.i.f. U.S. ports.
4/ Defined as imports - exports + adjustments for Government and industry stock changes.
5/ See page 182 for definitions.
6/ Does not include antimony recovered as byproduct of smelting domestic lead ores.
7/ Excludes U.S. production.

Prepared by P. A. Plunkert, telephone number (202) 634-1083.

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7. Government Stockpile:

Stockpile Status--9-30-85				
Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Antimony	36,000	37,843	1,843	928

8. Events, Trends, and Issues: Reported consumption and smelter production of primary antimony in 1985 remained at levels comparable to those of the previous year. With the continuing decline in antimony recovery from old scrap, the United States has become increasingly dependent on imported material to meet its total industrial demand for antimony. In 1985, China remained the major supplier of antimony material to the United States. In September, the General Services Administration completed its sale of excess antimony metal from the National Defense Stockpile authorized by Public Law 98-525.

The consumption of antimony oxide as a flame retardant continued as the dominant market for primary antimony. The use of antimony as a hardening agent in lead acid batteries, which has declined over the last several years, was believed to have leveled off, as the range in the types of alloys used in automotive batteries has begun to narrow.

From a 1983 base, demand for antimony is expected to increase at an average annual rate of about 1.1% through 1990. Reliance on imports of both metal and concentrates is expected to continue as domestic producers supply only a small portion of the primary demand. It is estimated that in 1986 U.S. apparent consumption will be 34,000 tons.

Environmental and ecological problems associated with the treatment of antimony metal and ores are minimal as emissions and effluents are controlled at the processing plants.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 5/
	1984	1985 e/	
United States 6/	557	W	100,000
Bolivia	10,700	10,000	350,000
Mexico	2,200	2,000	250,000
South Africa, Republic of	9,900	9,000	280,000
Yugoslavia	990	1,500	100,000
Other Market Economy Countries	7,160	8,800	1,135,000
Centrally Planned Economies	27,350	27,300	2,960,000
World Total	58,857	7/58,600	5,175,000

10. World Resources: United States resources are mainly in Idaho, Nevada, Alaska, and Montana. Principal identified world resources, estimated at 5.6 million tons, are in China, Bolivia, the U.S.S.R., the Republic of South Africa, and Mexico. Additional antimony resources may occur in Mississippi Valley-type lead deposits in the Eastern United States.

11. Substitutes: Compounds of titanium, zinc, chromium, tin, and zirconium may be substituted for antimony chemicals in paint, pigments, frits, and enamels. Combinations of calcium, strontium, tin, copper, selenium, sulfur, and cadmium can be used as substitutes for hardening lead. Selected organic compounds and hydrated aluminum oxide are widely accepted alternative materials in flame-retardant systems.

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ARSENIC

(Data in metric tons of arsenic trioxide (As_2O_3), unless noted) 1/

1. Domestic Production and Use: Arsenic trioxide was recovered as a byproduct of the smelting of high-arsenic copper concentrates and arsenic-bearing residues. Production of crude arsenic trioxide (95% minimum purity) and arsenic metal came from one plant in Tacoma, WA, primarily from imported copper concentrates. One company in Conley, GA, refined imported low-grade arsenic trioxide (70%-90%) for use in the production of arsenical wood preservatives, and one company in Laramie, WY produced arsenic acid for the wood preservative industry directly from nonferrous arsenical dusts. Four producers of agricultural chemicals and two producers of wood preservative chemicals consumed most of the domestic supply of arsenic. Metallic arsenic was used primarily in nonferrous alloying. Approximately 10 tons of high-purity arsenic metal was used in the electronics industry for the production of semiconductor materials. The estimated end use distribution of arsenic in 1985 was 62% in industrial chemicals (wood preservatives), 30% in agricultural chemicals (herbicides and desiccants), 4% in glass, 2% in nonferrous alloys, and 2% in other uses.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, refinery	W	W	W	W	W
Imports for consumption:					
Metal, arsenic content	293	136	243	304	450
Arsenic trioxide	17,198	14,599	10,186	13,985	18,000
Arsenic compounds, gross weight 2/	1,606	1,726	3,555	2,635	2,800
Exports, compounds, gross weight	523	2,658	85	76	200
Consumption, apparent	W	W	W	W	W
Price, cents per pound, yearend:					
Trioxide, domestic, 95% As_2O_3, f.o.b. Tacoma, WA	40	40	33	33	33
Trioxide, Mexican, 99.13% As_2O_3, f.o.b. Laredo, TX	78	59	45	42	42
Metal, domestic, 99% As, 2,000-lb. lots	275	245	225	210	210
Stocks, yearend, producer	W	W	W	W	W
Employment	Not available				
Net import reliance 3/ as percent of apparent consumption	W	W	W	W	W

3. Recycling: None.

4. Import Sources (1981-84): Sweden 29%, Canada 29%, Mexico 22%, France 8%, Other 12%.

5. Tariff:

	Number	Most Favored Nation (MFN)		Non-MFN
		1/1/86	1/1/87	1/1/86
Metal	632.04	0.3¢/lb	Free	6¢/lb
Trioxide & sulfide	417.62 & 417.60	Free	Free	Free
Other compounds	417.64	3.9% ad val.	3.7% ad val.	25.0% ad val.

6. Depletion Allowance: 14% (Domestic, 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
1/ Arsenic trioxide (As_2O3) contains approximately 76% arsenic by weight.
2/ Arsenic compounds include other arsenic compounds (TSUS 417.64), arsenic sulfide (TSUS 417.60), arsenic acid (TSUS 416.05), sodium arsenate (TSUS 420.70), and lead arsenate (TSUS 419.00).
3/ Defined as imports - exports + adjustments for Government and industry stocks changes.
4/ See page 182 for definitions.
5/ Excluding U.S. production.

Prepared by D. L. Edelstein, telephone number (202) 634-1053.

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8. Events, Trends, and Issues: The apparent demand for arsenic in 1985 increased markedly above the 1984 level and approached that of the peak demand of 1981. Increased consumption of arsenic trioxide by the wood preservative industry in formulating chromated copper arsenate (CCA) wood preservatives accounted for the increase in demand. Agricultural uses of arsenicals declined slightly from the level of the previous year in response to slightly lower acreage devoted to cotton production, the principal agricultural market for arsenical herbicides and desiccants.

It is estimated that in 1986 there will be little or no domestic mine production of arsenic trioxide. From an adjusted 1983 base, demand for arsenic is expected to increase at an average annual rate of about 1.2% through 1990.

In March, copper smelting operations at the Tacoma, WA smelter were terminated. The closure was ascribed to the high cost associated with bringing the smelter into compliance with environmental regulations. However, production of arsenic trioxide from stockpiled residues, and shipments to consumers continued until yearend. Shipments of arsenic trioxide were expected to end by early 1986. Arsenic metal production at Tacoma, which comes from imported trioxide, also continued throughout the year. Future plans for continued production of arsenic metal were uncertain, though shipments were expected to continue during 1986. Some of the increase in imports of arsenic trioxide, and hence some of the increase in apparent demand, was due to consumers seeking to establish reliable alternative supplies in anticipation of the Tacoma plant closure. Owing to expanding capacity in Chile, the Philippines and France, and to the availability of Chinese material, the Tacoma plant closure was not expected to create supply shortages of arsenic trioxide.

Implementation of regulations issued by the Environmental Protection Agency (EPA) in July 1984 on the use and handling of arsenical, creosote and pentachlorophenol wood preservatives was delayed pending resolution of challenges filed by the wood preserving industry. Similarly, final EPA regulations governing arsenic emissions from copper smelters and glass manufacturing plants were pending since 1983.

9. World Refinery Production and Reserve Base:

	Refinery Production		Reserve Base 4/
	1984	1985 e/	
	W	W	
United States			80,000
Chile e/	3,500	3,500	
France e/	5,000	6,000	
Mexico	4,500	4,500	
Namibia	2,504	2,500	
Peru	1,100	1,000	1,420,000
Philippines e/	NA	5,000	
Sweden e/	5,900	6,000	
Other Market Economy Countries	2,170	2,500	
U.S.S.R. e/	8,000	8,000	
World Total (may be rounded)	5/33,000	5/39,000	1,500,000

10. World Resources: World resources of copper and lead contain about 11 million tons of arsenic. Substantial resources of arsenic occur in copper ores in northern Peru and the Philippines, and in copper-gold ores in Chile. In addition, world gold resources, particularly in Canada, contain substantial resources of arsenic.

11. Substitutes: Substitutes for arsenic exist in most major end uses, although arsenic may be the preferred material due to lower cost and superior qualities. In agricultural uses, synthetic organic compounds such as paraquat may be substituted for arsenical pesticides, herbicides and desiccants. The wood preservatives pentacholorophenol and creosote may be substituted for chromated copper arsenate where odor and paintability are not a problem. Non-wood alternatives such as concrete and steel may be substituted for arsenical pressure treated wood. There are no available alternatives to the use of arsenicals as growth regulators for grapefruit and for control of some grape diseases.

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ASBESTOS

(Data in thousand metric tons, unless noted)

1. Domestic Production and Use: Three firms in California and Vermont produced all the domestic asbestos valued at $20 million in 1985. Manufacture of asbestos products by approximately 300 firms was centered in the Eastern States. Uses were friction products, 22%; flooring products, 21%; asbestos-cement pipe, 16%; coatings and compounds, 10%; packing and gaskets, 6%; asbestos-cement sheet, 5%; roofing products, 3%; paper and textiles, 1%; and other, 16%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production (sales): Mine	76	64	70	57	61
Imports for consumption	338	242	196	210	152
Exports	64	59	55	40	6
Shipments from Govt. stockpile excesses			None		
Consumption, apparent	349	247	217	226	207
Price: Average value, dollars per ton, f.o.b. mine	406	392	399	422	362
Stocks: Consumer, yearend	85	85	79	80	80
Employment: Mine and mill e/	225	215	190	190	180
Net import reliance 1/ as a percent of apparent consumption 2/	79	74	65	75	71

3. Recycling: Insignificant.

4. Import Sources (1981-84): Canada 94%, Republic of South Africa 5%, Other 1%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Asbestos	518.11	Free	Free	Free

6. Depletion Allowance: 22% (Domestic), 10% (Foreign).

7. Government Stockpile:

Stockpile Status--9-30-85

Material (metric tons)	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Chrysotile				
stockpile grade	2,722	8,881	4,250	0
nonstockpile grade		831	830	0
Total		9,712	5,080	0
Amosite				
stockpile grade	15,422	30,854	0	0
nonstockpile grade		1	0	0
Total		30,855	0	0
Crocidolite	0	33	0	0

e/ Estimated.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ Stockpile grades of asbestos were available only from Zimbabwe in 1984.
3/ See page 182 for definitions.

Prepared by R. A. Clifton, telephone number (202) 634-1206.

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8. Events, Trends, and Issues: Domestic demand for asbestos dropped 11% to the smallest demand since 1938. The 1985 decrease left the market at only 25% of the 1973 high. Large mine surpluses still exist, and domestic production decreased slightly. Imports decreased 28%. From a 1983 base, demand is expected to increase at an average annual rate of 4.4 through 1990. It is estimated that in 1986 domestic mine production of asbestos will be 61,000 tons and U.S. apparent consumption 230,000 tons.

Shortages prior to 1980 and environmental problems probably have resulted in permanent losses of U.S. market segments. High dependence on imports to satisfy demand for each grade and variety of asbestos continued in 1985. Canadian producers, some with corporate ties to U.S. firms, provided 94% of the total asbestos imported. Domestic users were totally dependent on the Republic of South Africa for crocidolite. Apparently no amosite was imported in 1985. Temporary mine closures were common during the first 6 months of 1985 in most asbestos producing countries.

The Occupational Safety and Health Administration's (OSHA) permanent proposal that would reduce the permissible exposure level to 0.5 fibers per cubic centimeter of air had not been promulgated by late 1985.

The Environmental Protection Agency (EPA) announced on February 1, 1985, that regulation of asbestos was being referred to OSHA and the Consumer Product Safety Commission (CPSC). This action, in effect, placed EPA's pending proposals to ban certain asbestos-containing products (A/C pipe, flooring felts, roofing felts and vinyl asbestos tile) and phase out of the remaining uses of asbestos over a 10-year period on indefinite hold. However, on March 8, the EPA Administrator informed Congress that the Agency was giving further review to the legal and policy questions raised by such a referral. Further action on the asbestos referral would not take place until these issues were resolved.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 3/
	1984	1985 e/	
United States	57	61	4,000
Canada (shipments)	922	1,000	37,000
South Africa, Republic of	170	180	22,000
Other Market Economy Countries	718	860	13,000
Centrally Planned Economies	2,471	2,500	28,000
World Total (may be rounded)	4,338	4,600	104,000

10. World Resources: The world has 200 million tons of identified resources and an additional 45 million tons classified as hypothetical resources. The U.S. resources are large but are mostly short fibers.

11. Substitutes: Environmental considerations aside, no single material has met the following set of criteria that would make it a viable substitute for asbestos: 1. It must have the strength of asbestos, 2. It must have the chemical inertness of asbestos, 3. It must have the durability of asbestos, and 4. It must approach the economy of asbestos. The substitute coming closest to meeting these criteria is still chrysophosphate which uses asbestos as the basic raw material.

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BARITE

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Barite production in 1985 continued to increase after 3 consecutive years of decline from the 1981 record high of 2.8 million tons valued at $102 million to 0.9 million tons valued at $25 million. The leading five companies supplied over 90% of the output. Production came from nine States, with 82% of the total from Nevada. Other leading States were Georgia and Missouri. About 2.4 million tons of ground barite from domestic production and imports was sold in 1985. Over 90% of the barite produced was used as a weighting agent in oil- and gas-well-drilling fluids mostly in the gulf coast area. Barite was also used in paints, and rubber, and for producing barium chemicals and glass.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, mine 1/	2,849	1,845	754	775	890
Imports for consumption (crude barite)	1,932	2,320	1,396	1,731	2,000
Exports	62	49	23	1	6
Consumption, apparent (crude barite)	4,719	4,116	2,127	2,505	2,880
Consumption 2/ (ground and crushed)	4,716	4,088	2,745	2,883	2,400
Price, average value, dollars per ton, mine	35.96	37.68	38.73	32.83	28.00
Stocks, producer, yearend			Not available		
Employment, mine and mill e/	2,150	1,500	1,000	1,000	900
Net import reliance 3/ as a percent of apparent consumption	40	55	65	69	69

3. Recycling: None.

4. Import Sources (1981-84): China 45%, Morocco 12%, Chile and Peru 10% each, Other 23%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Crude barite	472.10	$1.27/long ton	$1.27/long ton	$4.00/long ton
Ground barite	472.12	$3.25/long ton	$3.25/long ton	$7.50/long ton
Blanc fixe	472.14	0.2¢/lb	0.2¢/lb	1.25¢/lb

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated.
1/ Sold or used by producers.
2/ Domestic and imported crude barite sold or used by grinding establishments.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ See page 182 for definitions.

Prepared by S. G. Ampian, telephone number (202) 634-1180.

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8. Events, Trends, and Issues: Demand for barite in 1985 increased 15% after 2 consecutive years of decline from the record highs of recent years, owing to an overall improvement in the domestic economy. Demand, strong during the first half of the year, tapered-off in the second. The sharp decline which had persisted from the latter half of 1982 until 1983 was due primarily to a continuing oil glut and economic downturn which resulted in lower oil- and gas-well-drilling activity. In 1985, primary producers of barite continued output at pre-1975 levels. Imports for consumption of lower cost foreign crude barite rose, after a decline in 1983, to just under the record high of 1982. Imports for the fourth consecutive year exceeded domestic production. Barite grinding capacity, escalated earlier to meet the higher demand, continued in a position to meet present and/or projected demand. From a 1983 base, barite demand is expected to increase at an average annual rate of under 2% through 1990. It is estimated that in 1986 domestic mine production will be 1.0 million tons and U.S. apparent consumption will be 3.0 million tons.

In 1985 ground Chinese and Moroccan drilling-mud-grade-barite imports, previously nil, were continuing to compete with domestically ground barite in the already depressed gulf coast area markets. Two integrated domestic barite producers and grinders, with mines and mills in Nevada and grinding facilities in Louisiana, Oklahoma and Texas merged operations. In addition, an independent grinder in Louisiana ceased operations.

The low cost and technical advantages of barite preclude substitutes in the drilling mud market. Transportation costs, the availability of cheaper imports, and the growth rate of barite demand affect the development of domestic barite resources. The principal environmental impact of barite mining is the land disturbance normally associated with mining. Barite dust from grinding plants can be controlled satisfactorily by air pollution control equipment.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 4/
	1984	1985 e/	
United States 1/	775	890	60,000
Canada	55	40	7,000
France	155	150	3,000
Germany, Federal Republic of	200	200	2,000
India	460	450	35,000
Ireland	220	200	3,000
Italy	118	100	4,000
Mexico	400	350	10,000
Morocco	330	350	11,000
Peru	180	150	4,000
Thailand	193	200	15,000
Yugoslavia	40	50	9,000
Other Market Economy Countries	1,200	1,100	88,000
China e/	1,100	1,200	150,000
U.S.S.R. e/	600	500	75,000
Other Centrally Planned Economies e/	280	300	20,000
World Total (may be rounded)	6,313	6,230	500,000

10. World Resources: In the United States, identified resources of barite are estimated to be 100 million tons, and the hypothetical resources include an additional 150 million tons. The world's barite resources in all categories are about 2 billion tons, but only about 500 million tons are identified.

11. Substitutes: In the drilling mud market, alternatives to barite include celestite, ilmenite, iron ores, and synthetic hematite manufactured in the Federal Republic of Germany. However, none of these substitutes has had major impact on the barite drilling mud industry.

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BAUXITE 1/

(Data in thousand metric dry tons, unless noted)

1. Domestic Production and Use: Four companies operated surface mines in Alabama and Arkansas in 1985, producing a total of 565,000 tons of bauxite valued at $9 million. About 88% of the total domestic and imported bauxite consumed was processed into alumina and an estimated 90% of the total alumina consumed went to primary aluminum smelters. The domestic annual alumina capacity at yearend 1985 was 5.91 million tons at six plants, five of which were in operation during the year.

2. Salient Statistics--United States: 2/

	1981	1982	1983	1984	1985 e/
Production, mine	1,510	732	679	856	565
Imports of bauxite for consumption 3/4/	13,300	10,400	7,900	9,800	9,100
Imports of alumina	3,978	3,182	4,030	4,466	4,000
Exports of bauxite 4/	52	65	104	110	57
Exports of alumina	730	590	602	659	368
Shipments from Govt. stockpile excesses			None		
Consumption, apparent, bauxite and alumina 5/	5,039	3,672	3,867	4,389	3,848
Price, dollars per ton, f.o.b. mine	8-20	8-20	13-20	13-20	13-20
Stocks, industry, yearend, bauxite	8,300	7,200	5,600	4,900	4,800
Employment, mine	290	140	155	180	150
Net import reliance 6/ as a percent of apparent consumption	94	96	96	96	97

3. Recycling: None.

4. Import Sources (1981-84): Bauxite: Guinea 39%, Jamaica 36%, Brazil 7%, Other 18%.
Alumina: Australia 75%, Jamaica 11%, Suriname 8%, Other 6%.

5. Tariff: Import duties on bauxite and alumina were abolished in 1971 by Public Law 92-151. Only imports from non-most-favored-nations, as defined by the 1979 Tokyo Round tariff agreements, are dutiable, and no country so designated supplied bauxite or alumina to the United States during the first 9 months of 1985.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: Receipt of 1 million long dry tons of Jamaican metal grade bauxite for the national stockpiles in 1985 completed deliveries under the contract between the General Services Administration and the Government of Jamaica. The inventory of metal grade bauxite was increased by 1985 deliveries to 66% of the goal. Delivery of 75,000 long calcined tons (LCT) of refractory grade bauxite from China was expected to be completed by yearend 1985, increasing the refractory bauxite inventory to 274,926 LCT (279,300 tons), or about 20% of the goal.

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Bauxite-abrasive grade	1,016	-	-	-
Bauxite-metal grade:				
Jamaica type	21,337	12,658	-	-
Suriname type	6,198	5,385	-	-
Bauxite-refractory grade, calcined	1,422	203	-	-

e/ Estimated.
1/ See also Aluminum.
2/ Includes U.S. Virgin Islands.
3/ Includes abrasive grade consumed in Canada.
4/ Includes all forms of bauxite, expressed as dry equivalent weights.
5/ The sum of the aluminum equivalents of U.S. bauxite production and net import reliance.
6/ Defined as imports - exports + adjustments for Government and industry stock changes (all in aluminum equivalents).
7/ See page 182 for definitions.

Prepared by L. H. Baumgardner, telephone number (202) 634-1081.

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8. Events, Trends, and Issues: The permanent closure of the St. Croix, VI alumina plant in 1985 reduced the U.S. annual alumina capacity by 635,000 tons while rated capacity was increased at the Point Comfort, TX alumina plant capacity by 200,000 tons per year, resulting in a net U.S. capacity of 5.91 million tons at yearend 1985. The average operating rate of domestic refineries was estimated to be 70% of capacity. Low prices and weak demand for primary aluminum and alumina-based refractories, chemicals, and abrasives combined to depress bauxite and alumina production. Bauxite production was 34% lower, bauxite imports 7% lower, alumina production 4% lower and alumina imports 10% lower than 1984 levels.

   Domestic bauxite production in 1986 is estimated to be less than 300,000 tons with U.S. apparent consumption of bauxite and alumina, expressed as aluminum equivalent, totaling 4 million tons. From a 1983 base, demand for primary metal and nonmetal uses of aluminum materials is expected to increase at an average annual rate of 4.4% through 1990. Increasing imports of metal and recycling of scrap metal will limit demand for bauxite and alumina for metal production to a rate of growth lower than that for primary metal.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 7/
	1984	1985 e/	
United States	856	565	40,000
Australia	29,300	27,000	4,600,000
Brazil	5,239	6,000	2,900,000
Greece	2,800	3,000	650,000
Guinea	13,160	12,000	5,900,000
Guyana	1,556	2,300	900,000
India	1,994	2,000	1,200,000
Jamaica	8,734	5,300	2,000,000
Suriname	3,454	1,100	600,000
Venezuela	-	-	350,000
Yugoslavia	3,347	3,100	400,000
Other Market Economy Countries	4,410	4,200	2,900,000
Hungary	2,994	2,900	300,000
U.S.S.R.	4,600	4,600	300,000
Other Centrally Planned Economies	2,220	2,200	200,000
World Total (may be rounded)	84,664	76,300	23,200,000

10. World Resources: Bauxite resources (reserves plus subeconomic and undiscovered deposits) are estimated to be 55 to 75 billion tons. The resources in millions of tons are as follows: The United States, 300 to 325; Caribbean and Central America Region, 2,000 to 3,000; South America, 19,000 to 25,000; Europe, 3,000 to 4,000; Africa, 15,000 to 20,000; Asia, 8,000 to 13,000; and Oceania, 7,000 to 10,000. Domestic resources of bauxite are inadequate to meet long-term demand, but the United States and most other major aluminum producing countries have virtually inexhaustible subeconomic resources of aluminum in materials other than bauxite.

11. Substitutes: Although bauxite is the only raw material used in the production of alumina on a commercial scale in the United States, research on processes to produce alumina from nonbauxitic materials has shown that the vast U.S. resource of clay is a technically feasible source of alumina. Other domestic raw materials such as anorthosite, alunite, coal wastes, and oil shales offer additional potential alumina sources. Although it would require new plants using new technology, alumina from these nonbauxitic materials could satisfy the demand for primary metal, refractories, aluminum chemicals, and abrasives. Synthetic mullite, produced from kyanite and sillimanite, could substitute for bauxite-based refractories, while silicon carbide and alumina-zirconia are acceptable, though more costly, substitutes for bauxite-based abrasives.

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BERYLLIUM

(Data in short tons of contained beryllium, unless noted)

1. Domestic Production and Use: One company in Utah mined bertrandite and converted both bertrandite and imported and domestic beryl to beryllium hydroxide in Utah, and processed the hydroxide into metal, its alloys, and compounds at a plant in Ohio. The only other company in the industry, with plants in Indiana and Pennsylvania, bought imported beryl and produced beryllium alloys. Beryllium consumption of 300 tons was worth $135 million, based on the producer price for metal ingots, and was used as metal in nuclear reactors and aerospace applications, 40%; as an alloy and oxide in electrical equipment, 35%; as an alloy and oxide in electronic components, 17%; and as compounds and metal in other applications, 8%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, mine	293	218	267	241	260
Imports for consumption	87	115	97	88	100
Exports	39	67	19	20	30
Shipments from Govt. stockpile excesses 1/	-	-	-	(31)	(30)
Consumption, apparent	303	150	279	333	300
Price, dollars:					
Domestic, metal, per pound	173	194	206	213	225
Imported ore, per s.t.u. (20 lbs) BeO	94	121	126	88	90
Stocks, consumer, yearend	98	214	281	226	230
Employment:					
Mine, fulltime equivalent employees e/	25	25	25	25	25
Primary refineries e/	400	400	400	400	400
Net import reliance 2/ as a percent of apparent consumption	3	E	4	28	12

3. Recycling: Insignificant.

4. Import Sources (1981-84): China 36%, Brazil 25%, Republic of South Africa 7%, Switzerland 5%, Other 27%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Ore and concentrates	601.09	Free	Free	Free
Unwrought beryllium waste and scrap	628.05	8.5% ad val.	8.5% ad val.	25.0% ad val.
Beryllium, wrought	628.10	9.0% ad val.	9.0% ad val.	45.0% ad val.
Beryllium-copper master alloy	612.20	6.6% ad val.	6.0% ad val.	28.0% ad val.
Beryllium oxide or carbonate	417.90	3.7% ad val.	3.7% ad val.	25.0% ad val.
Other beryllium compounds	417.92	3.9% ad val.	3.7% ad val.	25.0% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimated. E Net exporter. NA Not available.
1/ Data in parentheses denote stockpile acquisitions.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 182 for definitions.
4/ Excluding China production data.

Prepared by D. Kramer, telephone number (202) 634-1083.

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7. Government Stockpile: By the end of September, 20 tons of beryllium metal purchased for the stockpile by the General Services Administration under a contract awarded in 1984 were delivered. Ten tons of metal remained on order for delivery by yearend 1985.

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Beryl ore (11% BeO)	720	720	-	-
Beryllium-copper master alloy	316	295	-	-
Beryllium metal	400	280	-	-

8. Events, Trends, and Issues: Weak demand in the electronics industry, the principal consumer of beryllium-copper alloys, contributed to the decrease in demand for beryllium in 1985. It is estimated that in 1986 beryllium concentrate production will remain at about the same level as in 1985, and U.S. apparent consumption of oxide, alloy, and metal will be 310 tons. From a 1983 base, demand for beryllium is expected to increase at an average annual rate of about 4% through 1990.

In late 1985, a domestic company which produced beryllium alloys announced its intention to sell its beryllium business. The sale would include the company's plant in Indiana that was completed in 1984. The only domestic beryllium concentrate producer reportedly plans to construct a plant in Japan to manufacture beryllium-copper alloys. The plant is expected to be completed in late 1986, and the alloys will be targeted toward electronic applications.

Beryllium dust and fines have been recognized as the cause of berylliosis, a chronic lung disease. Harmful effects are minimized by maintaining a clean workplace and requiring use of safety equipment.

9. World Mine Production and Reserve Base:

	Mine Production 1984	Mine Production 1985 e/	Reserve Base 3/
United States	241	260	The United States has very little beryl that can be economically handsorted from pegmatites. The Spor Mountain area, Utah, contains a large reserve base of bertrandite, which was being mined. Domestic deposits of bertrandite ores contain about 14,000 tons of beryllium. The world reserve base is not adequately delineated.
Brazil	55	50	
Rwanda	2	2	
Zimbabwe	2	2	
Other Market Economy Countries	3	3	
China	NA	NA	
Other Centrally Planned Economies	84	85	
World Total 4/	387	402	

10. World Resources: No quantitative information is available on foreign resources of beryllium-bearing minerals and rocks. The identified resources of beryllium in known domestic deposits are estimated at 80,000 tons of contained beryllium.

11. Substitutes: Because of the relatively high price of beryllium, uses are expected to continue principally in applications which require its light weight, high strength, high thermal conductivity, and neutron moderating and reflecting capability. Steel, titanium, or graphite composites may be substituted for beryllium metal, and phosphor bronze for beryllium-copper alloys, but with substantial loss of performance.

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BISMUTH

(Data in thousand pounds of bismuth content, unless noted)

1. Domestic Production and Use: All domestic production was derived from processing intermediate metallurgical products, such as lead bullion, which contain bismuth as a minor constituent. One company in Nebraska accounted for all domestic primary production. Consumption continued to be centered in the industrial belt of the northern and eastern United States. Fifty-three companies east of the Mississippi River accounted for 89% of the bismuth consumption. Based on an estimated average dealer price of $5.38 per pound, reported consumption was valued at $13.5 million. Bismuth was used in pharmaceuticals and chemicals, 59%; manufacturing of parts for machinery, 23%; primary metal industries, 16%; and other uses, 2%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, refinery	W	W	W	W	W
Imports for consumption	2,436	2,026	1,972	1,948	1,800
Exports 1/	79	53	306	312	500
Shipments from Govt. stockpile excesses			None		
Consumption, reported	2,393	1,876	2,285	2,648	2,500
Price, average, domestic dealer, dollars per pound	2.32	1.61	1.72	4.27	5.38
Stocks, yearend, consumer	509	542	577	480	600
Employment, plant e/	40	30	30	30	30
Net import reliance 2/ as a percent of apparent consumption	W	W	W	W	W

3. Recycling: Insignificant.

4. Import Sources (1981-84): Peru 33%, Mexico 31%, United Kingdom 15%, Canada 6%; Other 15%.

5. Tariff: In 1985, bismuth alloys and compounds imported from Mexico and Peru had a special free tariff rate.

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Metal, unwrought	632.10	Free	Free	7.5% ad val.
Alloys	632.66	5.9% ad val.	5.5% ad val.	45.0% ad val.
Compounds	418.00 & 423.80	7.9% ad val.	7.0% ad val.	35.0% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile:

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 months
Bismuth	2,200	2,081	-	-

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
1/ Including bismuth, bismuth alloys, and waste and scrap.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ Most of reserve base is bismuth recoverable from the lead reserve base.
4/ See page 182 for definitions.
5/ Excluding U.S. production.

Prepared by J. F. Carlin, Jr., telephone number (202) 634-1073.

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8. Events, Trends, and Issues: Primary production of bismuth in the United States remained about the same as that of 1984, as the single producing plant continued to operate well below its estimated annual capacity of 1.1 million pounds. Consumption of bismuth declined slightly in 1985. It is estimated that in 1986 U.S. reported consumption of bismuth will be 2.6 million pounds.

From a 1983 base, demand for bismuth is expected to increase at an average annual rate of about 1.4% through 1990. Reliance on imports of metal was expected to continue.

The sole domestic primary bismuth producer did not publish a bismuth list price in 1985. Dealer prices generally decreased throughout the year from $6.70 to $4.40 per pound as the temporary shortages of the prior year were eliminated.

The steel industry continued to experiment with and began commercial production of free-machining alloy bar steels that used bismuth as an additive. Research was conducted on bismuth usage as a smoke and fire retardant and in electronic applications.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 3/4/
	1984	1985 e/	
United States	W	W	30,000
Australia	3,310	3,200	60,000
Bolivia	10	100	12,000
Canada	440	400	20,000
Japan	1,240	1,100	127,000
Korea, Republic of	200	200	10,000
Mexico	1,300	1,000	30,000
Peru	1,160	1,000	92,000
Other Market Economy Countries	-	-	22,000
Centrally Planned Economies	1,000	1,100	47,000
World Total	5/8,660	5/8,100	450,000

10. World Resources: Bismuth in the United States is expected to continue to be recovered as a byproduct from domestic and imported lead ores and concentrates. Other potential sources include byproduct recovery from molybdenum and tungsten ores, and ash from West Virginia coal. Bismuth is known to occur in lead deposits in the Appalachian Mountains from Maine to Virginia. Large unmeasured quantities of bismuth are also present in Mexico, Bolivia, Peru, Australia, China, North Korea, and the Republic of Korea.

11. Substitutes: Antibiotics, magnesia, and alumina can replace bismuth in pharmaceutical uses. Mica and fishscales are acceptable substitutes in cosmetics. Iron, phosphorus, and potassium can be used for bismuth as a catalyst for production of acrylonitrile. Tellurium can replace bismuth as a steel additive, and plastics can substitute for bismuth alloys in holding devices and jigs for some applications. Generally, however, these substitutes are not competitive with bismuth on the basis of cost or quality.

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BORON

(Data in thousand short tons of boric oxide (B_2O_3), unless noted)

1. Domestic Production and Use: Domestic production of boron minerals, primarily sodium borates, by three companies was centered in southern California. The largest producer operated an open pit tincal and kernite (sodium borate) mine and plant. A second firm with two facilities using Searles Lake brines as raw material accounted for the remaining sodium borate output. The third firm produced colemanite (calcium borate) and ulexite/probertite (calcium-sodium borate) from an underground mine in Death Valley.

   Total production of boric oxide contained in minerals and compounds in 1985 was estimated to be 630,000 tons valued at $443 million. Firms primarily in the North Central and Eastern States were the chief consumers. Principal uses for boron compounds consumed in the United States were in glass products.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production 1/	740	607	637	667	630
Imports for consumption: Colemanite	22	2	16	20	24
Ulexite	18	14	11	47	55
Boric acid	1	2	4	4	5
Exports, gross weight of boric acid and refined borates	274	262	263	2/546	2/500
Consumption, reported	373	266	341	375	380
Price, dollars per ton, granulated pentahydrate borax in bulk, f.o.b. mine	186	201	201	208	208
Stocks, yearend 3/		Not available			
Employment	1,800	1,700	1,400	2,400	1,300
Net import reliance 4/ as a percent of apparent consumption		Net exporter			

3. Recycling: Insignificant.

4. Import Sources (1981-84): Boric acid: Turkey 66%, Italy 18%, Argentina 10%, Other 6%.
   Colemanite: Turkey 100%.
   Ulexite: Turkey 100%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Boric acid	416.10	1.5% ad val.	1.5% ad val.	8.5% ad val.
Calcium borate, crude	418.12	Free	Free	Free
Mineral articles and substances (ulexite)	523.81	Free	Free	Free

6. Depletion Allowance: Borax 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated.
1/ Minerals and compounds sold or used by producers, including both actual mine production and a marketable ore equivalent of brine products.
2/ Source: The Journal of Commerce Port Import/Export Reporting Service. Includes crude borates.
3/ Stocks data are not available and are assumed to be zero for net import reliance and apparent consumption calculations.
4/ Defined as imports - exports + adjustments for Government and industry stock changes.
5/ See page 182 for definitions.
6/ Gross weight of ore in thousand short tons.
7/ Less than 1/2 unit.

Prepared by P. A. Lyday, telephone number (202) 634-1177.

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8. Events, Trends, and Issues: At yearend, the only domestic producer of colemanite announced plans to temporarily cease mining operations early in 1986. The decision would affect about 300 employees at 4 locations and was a result of the strong U.S. dollar and increased world supply of borates. The owner of the domestic colemanite producer purchased an aerospace and strategic materials group that is a large user of glass-fiber-reinforced plastics.

Several domestic brine properties were wholly or partially for sale and one deposit that was proposed to use a solution mining process was also seeking capital for development.

In June, a new Turkish mining law was enacted that allows the state-owned mining company to keep title to boron deposits now being mined. The permits for exploration and development of new discoveries can now be granted to the private sector, but there are strict limitations on available areas.

From a 1983 base, demand for boric oxide is expected to increase at an average annual rate of about 3.2% through 1990. It is estimated that in 1986 domestic mine production of boric oxide will be 650,000 tons and U.S. apparent consumption will be 385,000 tons.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 5/ 6/
	1984	1985 e/	
United States 1/	66,	630	230,000
Argentina	33	33	10,000
Bolivia	-	-	21,000
Chile	7/	7/	45,000
Peru	3	3	24,000
Turkey	328	370	160,000
China	6	6	40,000
U.S.S.R.	44	44	150,000
World Total (may be rounded)	1,080	1,090	680,000

10. World Resources: Large domestic resources of borate materials occur in California, chiefly in sediments and their contained brines. Extensive resources also occur in Turkey. World resources are adequate to supply needs at current rates for the foreseeable future.

11. Substitutes: Substitution for borates is possible in such applications as soaps, detergents, enamel, agriculture, and insulation.

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BROMINE

(Data in million pounds of bromine content, unless noted)

1. Domestic Production and Use: The estimated value of elemental bromine sold or used by domestic producers in 1985 was $80 million. Five companies operated nine bromine-producing plants in Arkansas and Michigan. Three of the companies produced about 99% of the output. No byproducts were obtained from Arkansas brines, but iodine, magnesium compounds, and calcium chloride, in addition to bromine, were produced from Michigan brines.

   Bromine sold by U.S. producers was used in the production of the gasoline additive ethylene dibromide, flame retardants, oil and gas drilling and completion fluids, methyl bromide, and other bromine compounds.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production 1/	377	401	370	385	350
Imports for consumption, elemental bromine and compounds	1	4	5	3	12
Exports, elemental bromine and compounds	2/56	2/47	56	113	112
Consumption, apparent	326	363	319	274	250
Price, cents per pound, bulk, purified bromine	26.5-28.0	31.0-32.5	33.0-34.5	33-34.5	33-34.5
Stocks, producer, yearend, elemental bromine e/	5	-	-	-	-
Employment, plants	410	410	410	370	350
Net import reliance 3/ as a percent of apparent consumption		Net exporter			

3. Recycling: Approximately 5% of the U.S. bromine production was converted to byproduct sodium bromide solutions which were recycled to obtain elemental bromide.

4. Import Sources (1981-84): Israel 84%, France 8%, United Kingdom 6%, Other 2%.

5. Tariff: In 1985, bromine imported from Israel had a special free tariff rate. In addition, the Free Trade Agreement changed the duty on 19 brominated compounds from Israel.

Item	Number	Most Favored Nation (MFN)		Non-MFN
		1/1/86	1/1/87	1/1/86
Bromine	415.05	2.4¢/lb	2.0¢/lb	10¢/lb
Ammonium bromide	4/417.23	3.2% ad val.	3.1% ad val.	25% ad val.
Calcium bromide	4/418.13	0.6% ad val.	Free	25% ad val.
Ethylene dibromide	429.28	0.7¢/lb + 3.8% ad val.	0.7¢/lb + 3.5% ad val.	6.0¢/lb + 30% ad val.
Hydrobromic acid	416.45	4.7% ad val.	4.2% ad val.	25% ad val.
Potassium bromate	420.36	3.3% ad val.	3.1% ad val.	25% ad val.
Potassium bromide	420.02	1.6¢/lb	1.5¢/lb	10¢/lb
Methyl bromide	429.48	4.0% ad val.	3.7% ad val.	25% ad val.
Sodium bromate	420.36	3.2% ad val.	3.1% ad val.	25% ad val.
Sodium bromide	420.82	4.2¢/lb	3.0¢/lb	10¢/lb
Tetrabromobisphenol	4/403.54	0.9¢/lb + 19.4% ad val.	0.7¢/lb + 19.4% ad val.	7¢/lb + 62% ad val.

6. Depletion Allowance: 5% on brine wells (Domestic and Foreign).

7. Government Stockpile: None.

e/ Estimated. NA Not available.
1/ Sold or used by U.S. producers.
2/ Compounds only.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ New TSUS number effective 1985.
5/ See page 182 for definitions.
6/ From waste bitterns associated with solar salt.
7/ From the Dead Sea.

Prepared by P. A. Lyday, telephone number (202) 634-1177.

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8. Events, Trends, and Issues: A producer in Michigan announced the closure of the network of brine wells that supply brine to one bromine facility by yearend 1986. The brine system included 72 production wells, 36 reinjection wells, 17 solution mining wells, and about 150 miles of pipeline. The closure is a result of brine spillage polluting drinking water.

Bromine is used as a scavenger for lead in leaded gasoline. The Environmental Protection Agency ordered the 1.1-gram-per-gallon limit on lead in gasoline slashed to 0.5 gram per gallon on July 1, 1985, and 0.1 gram per gallon by January 1, 1986. The phasedown applied to all U.S. refiners and blenders. A decision to ban leaded gasoline has been proposed for 1988, although many truck, farm, and marine engines have special problems with unleaded fuels. The decrease in leaded gasoline will cause a decrease in bromine used in gasoline.

A Free Trade Agreement with Israel changed U.S. tariff rates immediately on some items and over a short period of time for other items. By 1995, all customs duties on trade items will be eliminated. A number of domestically produced bromine compounds could be adversely affected by increased competition of imports from Israel. To reduce the potential for harm, an amendment during 1985 to the Generalized System of Preferences (GSP) provided separate import categories for select bromine compounds to allow the Government to monitor the imports. Israel will continue to be eligible for the GSP throughout the staging process.

Israel announced plans for a $1 billion expansion of associated government operations that included increased bromine and bromine compounds production to 265 and 220 million pounds, respectively. The increases will be financed by issuing shares of up to 26% of a government-owned firm on the American Stock Exchange.

It is estimated that in 1986 domestic production of bromine will be 330 million pounds and U.S. apparent consumption will be about 230 million pounds. From a 1983 base, demand for bromine is expected to increase at an average annual rate of about 1% through 1990.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 5/
	1984	1985 e/	
United States 1/	385.0	350.0	25,000
France	25.0	25.0	3,500
Germany, Federal Republic of	7.0	7.0	600
India	.8	.8	6/
Israel	198.4	220.0	7/
Italy	1.1	1.0	6/
Japan	26.5	26.0	1,800
Spain	.7	.6	6/
United Kingdom	57.3	50.0	6/
China	-	-	NA
U.S.S.R.	154.0	160.0	3,000
World Total (may be rounded)	855.7	840.4	NA

10. World Resources: Resources of bromine are virtually unlimited. The Dead Sea in the Middle East is estimated to contain 1 billion tons of bromine. Seawater contains about 65 parts per million of bromine or an estimated 100 trillion tons. The bromine content of underground water in Poland has been estimated at 36 million tons.

11. Substitutes: Chlorine and iodine may be substituted for bromine in a few chemical reactions and for sanitation purposes. Aniline and some of its derivatives, methanol, ethanol, and gasoline-grade tertiary butyl alcohol are effective nonlead substitutes for ethylene dibromide and lead in gasoline. There are no substitutes for bromine in various oil and gas well completion and packer applications. Antimony oxide, alumina, organic chlorine compounds, and phosphorus compounds can be substituted for bromine as fire retardants for some uses.

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CADMIUM

(Data in metric tons of cadmium content, unless noted)

1. Domestic Production and Use: Cadmium was recovered as a byproduct of smelting domestic and imported zinc concentrates. Domestic refinery output, valued at $4.2 million, was produced by four companies operating five plants located in Colorado, Illinois, Oklahoma, Tennessee, and Texas. The estimated consumption pattern was coating and plating, 35%; batteries, 25%; pigments, 20%; plastics and synthetic products, 15%; and alloys and other uses, 5%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, refinery	1,603	1,007	1,052	1,686	1,600
Imports for consumption: Metal	3,090	2,305	2,196	1,889	2,000
Flue dust	-	11	-	-	-
Exports, all forms	239	11	170	106	100
Shipments from Govt. stockpile excesses			None		
Consumption, apparent	4,378	3,728	3,763	3,371	3,500
Price, dollars per pound, producer, in 1 to 5 short ton lots, average	1.93	1.11	1.13	1.69	1.20
Stocks, yearend, producer and consumer	1,844	1,417	732	830	800
Employment e/, smelter and refinery	300	250	250	250	200
Net import reliance 1/ as a percent of apparent consumption	63	73	72	50	55

3. Recycling: Cadmium usage was largely dissipative. Recycling has been practical only for nickel-cadmium batteries and some alloys and industrial wastes.

4. Import Sources (1981-84): Metal--Canada 32%, Australia 23%, Peru 8%, Mexico 7%, Other 30%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Flue dust	603.20	Free	Free	Free
Metal	632.14	Free	Free	15¢/lb

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile:

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Cadmium	5,307	2,871	-	-

e/ Estimated.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ See page 182 for definitions.

Prepared by P. A. Plunkert, telephone number (202) 634-1083.

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8. Events, Trends, and Issues: Domestic cadmium refinery production continued to fall short of satisfying domestic demand, but imports of metal and stock withdrawals made up the shortfall. In April, company officials announced the indefinite closure of a zinc refinery and its accompaning cadmium plant located in Corpus Christi, TX. Of the various applications for cadmium, the usage of cadmium in nickel-cadmium batteries has the highest probable growth potential. Research has provided some potential new uses for cadmium sulfide and cadmium telluride in solar photovoltaic cells. It is estimated that in 1986 domestic refinery production of cadmium will be 1,500 tons and U.S. apparent consumption will be 3,600 tons. From a 1983 base, demand for cadmium is expected to increase at an average annual rate of 1.7% through 1990.

The domestic producer price of cadmium at the beginning of 1985 ranged from $1.25 to $1.55 per pound. The price quotes decreased during the first half of the year and by late July producers listed a price of $1.00 per pound. Dealer prices which began the year at $1.11 to $1.15 per pound fluctuated during the year. By November, the dealer price was $0.77 to $0.81 per pound. Although quoted producer prices have tended historically to be higher than dealer prices, both prices have followed the same general trends.

Concern over the dispersal of toxic materials has had the dual effect of increasing cadmium recovery at primary smelters and reducing the amount of cadmium dissipated in the environment through industrial operations.

9. World Refinery Production and Reserve Base:

	Refinery Production		Reserve Base 2/
	1984	1985 e/	
United States	1,686	1,600	210,000
Australia	1,200	1,200	145,000
Belgium	850	850	-
Canada	1,200	1,200	170,000
Japan	2,400	2,400	15,000
Mexico	650	650	40,000
Other Market Economy Countries	5,435	5,400	295,000
Centrally Planned Economies	4,266	4,200	95,000
World Total	17,687	17,500	970,000

10. World Resources: World resources of cadmium are estimated at about 9 million tons. Because of the geochemical association of zinc and cadmium, resources of cadmium are estimated to be 0.3% of zinc resources. Large potential resources of cadmium are contained in the zinc-bearing coals of mid-continent United States and perhaps in Carboniferous-age coals of other countries. Undiscovered cadmium resources are estimated to be 5 million to 50 million tons of content depending on the ore-occurrence model used.

11. Substitutes: Coatings of zinc or vapor deposited aluminum can be substituted for some cadmium plating applications. Plastic stabilizers formulated with tin may be used in place of cadmium compounds. Zinc and iron pigments can be used in place of cadmium pigments but often at the risk of reduced performance.

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CEMENT

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: One State agency and 48 companies operated 143 plants in 40 States to produce 76 million tons of portland cement, 3 million tons of masonry cement, and minor quantities of calcium aluminate cement in 1985. The value of this production was $4.4 billion. By yearend, the capacity of 130 plants producing portland cement clinker, including 3 white cement facilities, was 276,000 tons per day. Allowing for an average of about 38 days downtime per year for maintenance and rebricking kilns, the apparent annual clinker production capacity was 90 million tons. An additional 11 plants operated grinding mills only for imported, purchased, or interplant transfers of clinker. Estimated finish-grinding capacity was 104 million tons. The 5 largest companies comprised 33% of the clinker production capacity; and the 10 largest accounted for 54%. Fifty percent of the portland cement production came from six States: Texas, California, Pennsylvania, Michigan, Missouri, and Alabama, in declining order. Uses for domestic cement were 69% for ready-mixed concrete; 13% for concrete products such as block, pipe, and prestressed precast concrete; 6% by building material dealers; 4% by highway contractors; and 8% by other contractors, government agencies, and miscellaneous.

2. Salient Statistics--United States: 1/

	1981	1982	1983	1984	1985 e/
Production (portland, masonry, and other)	71,710	63,355	70,420	77,700	80,000
Shipments from mills (includes masonry cement)	71,748	64,066	70,933	80,166	84,000
Imports for consumption	3,963	2,911	4,221	8,689	14,000
Exports	300	201	118	80	85
Consumption, apparent 2/	73,321	65,623	73,435	84,313	90,000
Price, average mill value, dollars per ton	51.89	50.94	49.95	51.80	53.57
Stocks, mill, yearend	7,372	6,753	6,711	6,866	6,700
Employment, mine and mill e/	22,000	20,000	20,000	20,000	19,500
Net import reliance 3/ as a percent of apparent consumption	4	5	6	10	15

3. Recycling: None.

4. Import Sources (1981-84): Canada 48%, Spain 15%, Mexico 15%, Venezuela 5%, Other 17%.

5. Tariff: 4/

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
White nonstaining portland cement	511.11	1¢/100 lb	Free	8¢/100 lb
Other hydraulic cement and clinker	511.14	Free	Free	6¢/100 lb

6. Depletion Allowance: Certain raw materials for cement production such as limestone, bauxite, and gypsum have depletion allowances.

7. Government Stockpile: None.

e/ Estimated.
1/ Excludes Puerto Rico.
2/ Adjusted to eliminate duplication of imports shipped by domestic cement manufacturers.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ Rates include weight of container.

Prepared by Wilton Johnson, telephone number (202) 634-1184.

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8. Events, Trends, and Issues: Total U.S. demand increased about 7% above that of 1984. The increase was due primarily to improved industrial, commercial, and residential construction activity. Finished portland cement production capacity utilization increased to about 76% compared with 72% in 1984. Utilization of clinker production capacity increased to 88% compared with 76% in 1984. Cement consumption increased in all except the East South Central Region. Regions experiencing the biggest gains were: New England, 17%; Middle Atlantic, 10%; and Pacific, 8%. All other regions experienced gains of 7% or less. From a 1983 base, demand for cement is expected to increase at an average annual rate of 2.0% through 1990. It is estimated that in 1986 domestic production of cement will be 82 million tons and U.S. apparent consumption will be 92 million tons.

   The gap between domestic production and demand continued to widen as the industry relied more heavily on imports to meet its cement requirements. Import reliance as a percent of apparent consumption was 15%, surpassing the 9% record level established in 1979.

   The trend continued toward consolidation of the industry through acquisition of companies and plants by larger firms, most of which were foreign owned. By yearend approximately 35% of cement production capacity was foreign owned. To increase efficiency and economy of energy use, cement producers continued to incorporate preheaters, some with flash calciners, and dry-process kilns into plant modernization programs. However, the level of modernization and expansion was considerably less in 1985 than in previous years.

   Environmental concerns have promoted the use of dust collectors and electrostatic precipitators to control atmospheric emissions of particulates, a major cost item in cement plant construction, renovation, and maintenance.

9. World Production and Capacity:

	Production		Yearend Clinker Capacity	
	1984	1985 e/	1984	1985 e/
United States (includes Puerto Rico)	78,700	81,000	92,000	92,000
France	26,500	28,000	30,000	30,000
Germany, Federal Republic of	34,700	35,000	46,000	46,000
Italy	44,100	45,000	55,000	55,000
Japan	86,900	87,000	121,000	121,000
Spain (includes Canary Islands)	33,100	35,000	39,000	39,000
United Kingdom	14,000	15,000	20,000	20,000
Other Market Economy Countries	365,300	366,000	506,000	506,000
China	133,500	134,000	135,000	135,000
U.S.S.R.	143,300	145,000	154,000	154,000
Other Centrally Planned Economies	99,000	100,000	108,000	108,000
World Total	1,059,100	1,071,000	1,306,000	1,306,000

10. World Resources: Although domestic resources of raw materials are adequate, they are sometimes remote from cement market areas. Countries deficient in one or more raw materials have experienced little difficulty importing their requirements.

11. Substitutes: Aluminum, steel, fiberglass, wood, stone, and clay products may be used in the building and construction markets.

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CESIUM 1/

(Data in pounds of cesium content, unless noted)

1. Domestic Production and Use: One firm in Pennsylvania imported pollucite, the principal commercial ore of cesium, and accounted for all of the domestic output of cesium products. Cesium, usually in the form of chemical compounds, was used mainly in research and development, including the development of magnetohydrodynamic (MHD) electric power generators, thermionic energy converters, and biological research. Cesium was used commercially in electronic, photoelectric and medical applications.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Mine			None		
Metal and compounds	W	W	W	W	W
Imports for consumption:					
Pollucite and metal			Not available		
Cesium compounds including cesium chloride, gross weight	24,000	17,000	19,000	54,000	60,000
Exports			Not available		
Consumption, apparent; metal and compounds			Not available		
Price, dollars:					
Pollucite, per short ton	400	350-400	350-400	350-400	350-400
Metal, per pound	275-325	275	275-325	275-325	280-330
Cesium oxide, per pound	NA	400	400	400	400
Cesium compounds, per pound	29-37	32-41	32-80	37-86	40-85
Stocks, producer, yearend	W	W	W	W	W
Employment, plant e/	25	25	25	25	25
Net import reliance 2/ as a percent of apparent consumption	100	100	100	100	100

3. Recycling: None.

4. Import Sources (1981-84): Pollucite: Canada 100%.
Compounds, including cesium chloride: Federal Republic of Germany 88%, Other 12%.

5. Tariff:

	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Ore and concentrate	601.66	Free	Free	Free
Cesium	415.10	5.7% ad val.	5.3% ad val.	25.0% ad val.
Cesium chloride	418.50	4.3% ad val.	4.0% ad val.	25.0% ad val.
Other compounds	418.52	4.1% ad val.	4.0% ad val.	25.0% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
1/ See also Rubidium.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 182 for definitions.

Prepared by W. Timothy Adams, telephone number (202) 634-1082.

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8. Events, Trends, and Issues: Preliminary data indicate that U.S. demand for cesium in 1985 was 8% greater than that in 1984. From a 1983 base, demand for cesium is expected to increase at an average annual rate of about 3.2% through 1990. However, requirements for research may cause significant changes in demand from year to year as occurred in 1985. The increase in demand in 1984 and 1985 was attributed to the experimental use of cesium as a catalyst activity promoter in petroleum cracking and petrochemical synthesis.

   The United States obtains cesium ore and a large part of its manufactured cesium compounds from foreign sources. Future cesium supplies are likely to be dependent upon foreign sources unless domestic deposits are discovered or technology is developed to use low-grade raw materials.

   The high cost and extreme reactivity of cesium limit its applications at present.

   Because of the small scale of production of cesium products, no significant environmental problems have been encountered.

9. World Mine Production and Reserve Base: Data on mine production of cesium are not available. Cesium forms independent minerals in pegmatites and is commonly obtained as a coproduct in the processing of titanium, beryllium, or lithium minerals. The reserve base 3/ is mainly associated with the cesium silicate mineral, pollucite, which contains about 20% cesium, and is located in Canada, 80,000 short tons of contained cesium, Zimbabwe, 25,000 tons, and Namibia, 10,000 tons. The reserve base appears to be sufficient for many years, provided the rate of growth in demand for cesium does not increase significantly.

10. World Resources: World resources of cesium are not known, but probably could be increased substantially by intensive exploration.

11. Substitutes: The properties of rubidium and its compounds are so similar to those of cesium and its compounds that compounds of rubidium and cesium are used interchangeably in many applications. Certain other elements can be substituted in light-sensing equipment, and potassium may be used instead of cesium in MHD power generation.

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CHROMIUM

(Data in thousand short tons, gross weight, unless noted)

1. Domestic Production and Use: The United States continued to be one of the world's leading consumers of chromium. Chromite was consumed by four firms producing chromium ferroalloys and metal, seven firms producing refractories, and two firms producing chromium chemicals. Most of these were in the Eastern United States. Of the chromite consumed, the chemical and metallurgical industry used 86% and the refractory industry 14%. Consumption of chromium ferroalloys, metal, and other chromium-containing materials by end use was about as follows: Stainless and heat-resisting steel, 78%; full-alloy steel, 10%; superalloys, 4%; and other alloys, 8%. The total value of chromium consumed as chromite and ferrochromium was estimated to be $180 million.

2. Salient Statistics--United States: 1/

	1981	1982	1983	1984	1985 e/
Production, chromite			None		
Imports for consumption	508	239	231	347	296
Exports	52	10	13	36	14
Consumption: Reported	349	232	301	315	381
Apparent 2/	510	319	329	459	390
Price, chromite, yearend:					
Turkish, dollars per metric ton, Turkey	110	110	110	110	110
South African, dollars per metric ton, South Africa	55	52	52	52	42
Stocks, consumer, yearend	251	209	175	156	148
Net import reliance 3/ as a percent of apparent consumption	90	85	76	81	73

3. Recycling: In 1985, estimated chromium contained in purchased stainless steel scrap amounted to 27% of chromium demand.

4. Import Sources (1981-84): Chromium contained in chromite and ferrochromium: Republic of South Africa, 56%; Zimbabwe, 11%; Yugoslavia, 6%; Turkey, 5%; Other, 22%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Ore and concentrate	601.15	Free	Free	Free
Low-carbon ferrochromium	606.22	3.3% ad val.	3.1% ad val.	30% ad val.
High-carbon ferrochromium	606.24	1.9% ad val.	No target duty	7.5% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: About 142,000 tons of chromite in the stockpile were converted to high-carbon ferrochromium for the General Services Administration (GSA). The GSA contracted to convert about 92,000 tons of chromite to high-carbon ferrochromium in 1986.

e/ Estimated.
1/ Data in thousand short tons of contained chromium.
2/ Calculated total demand for chromium.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ See page 182 for definitions.
5/ Shipping grade ore is deposit quantity and grade normalized to 45% Cr_2O_3 for high-chromium and high-iron chromite and 35% Cr_2O_3 for high-alumina chromite.

Prepared by J. F. Papp, telephone (202) 634-1028.

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Stockpile Status--9-30-85

Material	Goal	Total Inventory	Average Chromium Content	Excess to Goal Authorized For Disposal	Sales, 9 Months
Chromite:					
Metallurgical-grade	3,200	1,949	28.6%	-	-
Chemical-grade	675	242	28.6%	-	-
Refractory-grade	850	391	-	-	-
Chromium ferroalloys:					
High-carbon ferrochromium	185	402	71.4%	-	-
Low-carbon ferrochromium	75	300	71.4%	-	-
Ferrochromium-silicon	90	57	42.9%	-	-
Chromium metal	20	4	-	-	-

In addition to data shown, the stockpile contained the following nonstockpile-grade materials: 341,777 tons of metallurgical-grade chromite and 20,762 tons of chromium ferroalloys.

8. Events, Trends, and Issues: Demand for chromium increased in 1985 compared with that of 1984. Chromium demand changes reflect changes in the steel industry, the major consumer of chromium. Compared with that of 1984, reported chromium consumption increased by 21%.

The published price of Turkish high-chromium chromite remained at $110 per metric ton, and South African high-iron chromite price declined from a range of $48 to $52 per metric ton to $40 to $42. The price of chromium metal, $3.75 per pound, remained unchanged.

From a 1983 base, demand for primary chromium is expected to increase at an average annual rate of about 6.5% through 1990. It is estimated that in 1986 domestic mine production of chromite will be zero, and U.S. apparent consumption of chromium will be about 400,000 tons.

9. World Chromite Mine Production and Reserve Base:

	Mine Production		Reserve Base 4/ (shipping grade) 5/
	1984	1985 e/	
United States	-	-	-
Brazil	310	300	10,000
Finland	280	300	32,000
India	485	500	66,000
Philippines	300	300	32,000
South Africa, Republic of	3,314	3,300	6,300,000
Turkey	670	700	80,000
Zimbabwe	500	500	830,000
Other Market Economy Countries	288	300	25,000
Albania	960	1,000	22,000
U.S.S.R.	3,300	3,300	142,000
Other Centrally Planned Economies	61	600	4,000
World Total (may be rounded)	10,468	10,600	7,500,000

10. World Resources: World resources total about 36 billion tons of shipping-grade chromite, sufficient to meet conceivable demand for centuries. Over 99% of these resources are in southern Africa, nearly 26 billion tons in the Republic of South Africa, and over 11 billion tons in Zimbabwe. Although the rest of the world's resources are measured in millions of tons, they are small in comparison with those of Africa. Most of the U.S. chromium resources are in the Stillwater Complex in Montana and beach sands of Oregon. Domestic chromite mining in the near future is doubtful.

11. Substitutes: Substitution possibilities for chromium include: Nickel for plating, iron for pigments, and boron for alloying. Magnesite may substitute for chromite in refractories.

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CLAYS
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: In 1985, clays were produced in all States except Alaska, Delaware, Hawaii, Rhode Island, Vermont, and Wisconsin. The leading 30 firms supplied about one-half of the output and approximately 300 firms the remainder. Together these firms operated about 1,100 mines. Estimated value of all marketable clay produced was a record high of $1.1 billion. In 1985 major domestic uses for specific clays were estimated as follows: Kaolin--43% paper, 7% refractories, 4% rubber; ball clay--27% dinnerware and pottery, 15% floor and wall tile, 16% sanitaryware; fire clay--35% firebricks, 10% foundry sands; bentonite--40% drilling mud, 21% foundry sand bond; 14% iron ore pelletizing; fuller's earth--66% absorbent and filtering uses, 11% insecticide dispersant; and common clay--95% construction materials.

2. Salient Statistics--United States: 1/

	1981	1982	1983	1984	1985 e/
Production, mine:					
Kaolin	7,660	6,362	7,203	7,953	7,850
Ball clay	845	642	747	860	910
Fire clay 2/	1,927	1,087	1,043	1,145	1,120
Bentonite	4,947	3,245	2,887	3,154	3,750
Fuller's earth	1,656	1,683	1,912	1,899	2,000
Common clay	27,543	22,326	27,066	29,225	30,000
Total	44,579	35,345	40,858	44,236	45,630
Imports for consumption	33	24	21	32	40
Exports	3,151	2,619	2,484	2,699	2,800
Consumption, apparent	41,461	32,750	38,395	41,569	42,870
Price	$2 to $300 per ton, depending on type and quality				
Stocks, yearend	Not available				
Employment: e/ Mine	2,400	2,000	2,000	2,100	2,100
Mill	10,000	9,500	9,000	9,500	9,500
Net import reliance 3/ as a percent of apparent consumption	Net exporter				

3. Recycling: Insignificant.

4. Import Sources (1981-84): United Kingdom 57%, Canada 21%, Mexico 15%, Federal Republic of Germany 5%, Other 2%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
China clay and kaolin 4/	521.41	33¢	33¢	$2.50
Fuller's earth, not beneficiated 4/	521.51	25¢	25¢	$1.50
Wholly or partly beneficiated 4/	521.54	50¢	50¢	$3.25
Bentonite 4/	521.61	40¢	40¢	$3.25
Ball clays, not beneficiated 4/	521.71	38.5¢	38¢	$1.00
Wholly or partly beneficiated 4/	521.74	78¢	77¢	$2.00
Other clays, not beneficiated 4/	521.81	Free	Free	$1.00
Wholly or partly beneficiated 4/	521.84	50¢	50¢	$2.00
Artificially activated clays	521.87	0.01¢/lb + 2.9% ad val.	2.5% ad val.	0.25¢/lb + 30% ad val.

6. Depletion Allowance: Kaolin, ball clay, bentonite, fuller's earth, and fire clay 14% (Domestic), 14% (Foreign); clay used for extraction of alumina or aluminum compounds, 22% (Domestic); clay and shale used for making brick, tile, and lightweight aggregate 7.5% (Domestic), 7.5% (Foreign); clay used in making drainage and roofing tile, flower pots, and kindred products, 5% (Domestic), 5% (Foreign).

e/ Estimated.
1/ Excludes Puerto Rico.
2/ Refractory uses only.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ Per long ton.

Prepared by S. G. Ampian, telephone number (202) 634-1180.

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7. Government Stockpile: None.

8. Events, Trends, and Issues: Total clays sold or used by domestic producers in 1985 increased 3% in tonnage and rose nearly 10% in value. This increase in production, continues to reverse the downward trend in total clay production that had persisted from 1983 to 1984. The clay producers operated between 60% to 90% of capacity during the year. Exports for the second time since 1980, in spite of the strong U.S. dollar, reversed the downward slide in U.S. clay exports by increasing shipments nearly 5% over that exported in 1984; however, exports were still at pre-1979 levels. From a 1983 base, demand for individual types of clays is expected to increase at an average annual rate of 2% to 4% through 1990. It is estimated that in 1986 domestic mine production of clays will be 48 million tons and U.S. apparent consumption will be 45 million tons. The continued growth of the energy intensive clay-based industries could be slowed again by the return of higher energy costs and lower construction rates. Average prices for most clays are expected to rise slowly, reflecting higher quality requirements for the specialty clays and increasing costs associated with land acquisition, land rehabilitation, and environmental and energy factors. Greater recovery of byproducts and coproducts should occur as processing technology improves and as problems of solid waste disposal become increasingly acute.

   Further enhancement of the U.S. position as a major world supplier of high-quality clays is assured by the possession of more than adequate resources of all major types of clay coupled with the clay processing technology necessary to provide large quantities of consistent-quality clays over extended periods.

   In 1985, imports of drilling-mud-grade attapulgite or fuller's earth were received, for the first time, in the gulf coast area.

9. World Mine Production and Reserve Base: Not available.

10. World Resources: Clays are divided for commercial purposes into kaolin, ball clay, fire clay, bentonite, fuller's earth, and common clay. Resources of these types of clay are extremely large, except for lesser resources of high-grade ball clay, fire clay, and sodium-bentonite. Resources of kaolin in Georgia are estimated to be 5 to 10 billion tons.

11. Substitutes: Limited substitutes and alternatives, such as talc and whiting, are available for filler and extender applications.

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COBALT

(Data in short tons of cobalt content, unless noted)

1. Domestic Production and Use: Domestic mine production ceased at the end of 1971. Most secondary cobalt is derived from recycled superalloy or cemented carbide scrap and from spent catalysts. One foreign company operated a plant, located in Laurinburg, North Carolina, to produce extra fine cobalt powder. The single domestic refiner of cobalt, located in Louisiana, was planning to close its facility in the last quarter of 1985. About 15 processors were active in the production of cobalt compounds in 1985. Industrial consumers totaled about 225, with the largest in Michigan, Pennsylvania, Indiana, and New Jersey. Cobalt consumption decreased after 2 consecutive years of increases. Superalloys, mainly for industrial and aircraft gas turbine engines, accounted for about 37% of reported consumption; magnetic materials, 17%; driers, 10%; catalysts, 10%; metal cutting and mining tool bits, 6%; and other, 20%. Total estimated value of cobalt consumed in 1985 was $173 million.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Mine			None		
Secondary	486	436	362	440	400
Imports for consumption	7,797	6,435	8,611	12,655	8,000
Exports e/	417	300	412	336	300
Shipments from Govt. stockpile excesses 1/	(1,165)	(1,435)	(132)	(99)	(2,750)
Consumption: Reported	5,840	4,734	5,660	6,472	7,000
Apparent	6,266	5,726	7,856	2/8,948	7,500
Price, average annual spot for cathodes, dollars per pound	14.58	8.56	5.76	10.40	11.50
Stocks, industry, yearend	4,188	3,733	4,305	5,411	3,261
Employment, mine			None		
Net import reliance 3/ as a percent of apparent consumption	92	92	95	95	95

3. Recycling: About 400 tons of cobalt was recycled from purchased scrap in 1985. This represented about 6% of estimated reported consumption for the year.

4. Import Sources (1981-84): Zaire 40%, Zambia 12%, Canada 12%, Norway 6% (originated in Canada), and Other 30%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Ore and concentrate	601.18	Free	Free	Free
Unwrought metal, waste and scrap	632.20	Free	Free	Free
Alloys, unwrought	632.86	9% ad val.	9% ad val.	45% ad val.
Chemical compounds:				
Oxide	418.60	1.2¢/lb.	1.2¢/lb.	20¢/lb.
Sulfate	418.62	1.4% ad val.	1.4% ad val.	6.5% ad val.
Other	418.68	4.4% ad val.	4.2% ad val.	30% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimated. NA Not available.
1/ Data in parentheses denote stockpile acquisitions.
2/ Of 1984 U.S. cobalt imports, 2,706 tons were destined for the National Defense Stockpile but did not officially enter the stockpile. To derive a meaningful apparent consumption figure, the 2,706 tons were treated as if they had gone into stocks. Also, the 99 tons of cobalt that officially entered the stockpile in 1984 were imported in 1983 and were not used in deriving the apparent consumption figure.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ See page 182 for definitions.

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7. Government Stockpile: About 500 tons of cobalt from Zambia and 250 tons of cobalt from Canada, purchased by the General Services Administration (GSA), arrived in the United States in 1985. These acquisitions, when officially accepted by the GSA, will bring the stockpile cobalt inventory up to 62% of the goal.

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months	Purchases, 9 Months
Cobalt	42,700	25,096	-	-	250

8. Events, Trends, and Issues: Demand for cobalt fell in 1985 after increases the two previous years. The spot price for cathode cobalt was stable during the year, hovering around the $11.50 per pound level. This was attributed to the efforts of producers to bring stability to the cobalt market.

Surplus market conditions are expected to prevail worldwide in 1986. Most of the surplus is in producers' stocks. It is estimated that in 1986, domestic mine production will be zero and U.S. apparent consumption will be about 7,500 tons. From a 1983 base, demand for cobalt is expected to increase at an average annual rate of about 3% through 1990.

The only domestic cobalt refinery was expected to close in the last quarter of 1985. The refinery's owner withdrew from the contract which had provided for two-thirds of its feedstock. The remainder was considered insufficient to support operations. Cobalt is almost invariably recovered as a byproduct of copper and/or nickel mining. Environmental problems encountered with cobalt recovery are generally those associated with the mining and processing of copper and nickel ores.

9. World Mine Production and Reserve Base:

	Mine Production 1984	Mine Production 1985 e/	Reserve Base 4/
United States	-	-	950,000
Australia	1,400	1,500	100,000
Canada	2,200	2,200	285,000
Finland	1,000	1,000	37,500
New Caledonia	280	300	950,000
Philippines	140	400	440,000
Zaire	18,700	18,000	2,300,000
Zambia	5,090	5,000	600,000
Other Market Economy Countries	1,845	1,500	1,300,000
Albania	390	400	NA
Cuba	1,690	1,800	2,000,000
U.S.S.R.	2,900	3,000	250,000
World Total (may be rounded)	35,635	35,100	9,200,000

10. World Resources: The cobalt resources of the United States are estimated to be about 1.4 million tons. Most of these resources are in Minnesota, but other important occurrences are in Missouri, Idaho, Montana, California, Oregon, and Alaska. Although large, most domestic resources are in subeconomic concentrations that will not be economically usable in the foreseeable future. The identified world cobalt resources are about 12 million tons. The vast majority of these resources are in nickel-bearing laterite deposits, with most of the rest occurring in nickel-copper sulfide deposits hosted in mafic and ultramafic rocks and in the sedimentary copper deposits of Zaire and Zambia. In addition, millions of tons of hypothetical and speculative cobalt resources exist in manganese nodules and crusts on the ocean floor.

11. Substitutes: Nickel may be substituted for cobalt in several applications but only with a loss of effectiveness. Various potential substitutes include nickel, platinum, barium or strontium ferrite and iron in magnets; tungsten, molybdenum carbide, ceramics, and nickel in machinery; nickel and ceramics in jet engines; nickel in catalysts; and copper, chromium, and manganese in paints.

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COLUMBIUM

(Data in thousand pounds of columbium content, unless noted)

1. Domestic Production and Use: There has been no significant columbium mining industry since 1959, the exception being small unreported quantities of columbium-bearing concentrates produced in 1980-82. Most metal, ferrocolumbium, other alloys, and compounds were produced by eight companies with nine plants. Feed for these plants included imported concentrates, tin slags, columbium oxide, and ferrocolumbium. Consumption was mainly as ferrocolumbium by the steel industry and as columbium alloys and metal by the aerospace industry with plants located in the Eastern and Midwestern United States, California, and Washington. Total estimated value of shipments of domestically produced ferrocolumbium, nickel columbium, and metal was about $40 million. End uses as metal and alloys in fabricated form were: Construction, 40%; transportation, 27%; oil and gas industries, 11%; machinery, 11%; and other, 11%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, mine	Small	Small	-	-	-
Imports for consumption:					
Concentrates, tin slags, and other e/1/	1,892	1,225	W	W	NA
Ferrocolumbium e/	6,068	3,128	2,539	4,343	3,800
Exports, concentrate, metal, alloys, waste, and scrap e/	91	88	78	80	100
Shipments from Govt. stockpile excesses	-	2/(26)	-	-	2/(213)
Consumption, reported:					
Raw material	1,983	e/1,900	e/1,900	e/2,600	NA
Ferrocolumbium 3/	6,244	3,679	4,318	5,399	5,400
Consumption, apparent	8,118	6,600	5,750	7,670	7,700
Price: Columbite, dollars per pound 4/	9.83	8.88	6.00	5.50	4.25
Pyrochlore, dollars per pound 5/	3.25	3.25	3.25	3.25	3.25
Stocks, industry, processor and consumer, yearend	8,332	e/5,971	W	W	NA
Employment, processor e/	600	500	500	500	500
Net import reliance 6/ as a percent of apparent consumption	100	100	100	100	100

3. Recycling: Insignificant.

4. Import Sources (1981-84): Brazil 74%, Canada 9%, Thailand 6%, Other 11%.

5. Tariff: In 1985, columbium oxide imported from Brazil was duty free.

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Columbium oxide	423.0050	3.9% ad val.	3.7% ad val.	25.0% ad val.
Columbium carbide	423.0094	3.9% ad val.	3.7% ad val.	25.0% ad val.
Columbium concentrate	601.2100	Free	Free	Free
Ferrocolumbium	606.5300	5.0% ad val.	5.0% ad val.	25.0% ad val.
Columbium, unwrought:				
Metal, waste, and scrap	628.1500	3.9% ad val.	3.7% ad val.	25.0% ad val.
Alloys	628.1700	5.2% ad val.	4.9% ad val.	25.0% ad val.
Columbium, wrought	628.2000	5.9% ad val.	5.5% ad val.	45.0% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
1/ Metal, alloys, synthetic concentrates, and columbium oxide.
2/ Data in parentheses denote stockpile acquisitions.
3/ Includes nickel columbium and a small quantity of other columbium materials.
4/ Average value, contained pentoxides for material having a Cb_2O_5 to Ta_2O_5 ratio of 10 to 1.
5/ Average value, contained pentoxide.
6/ Defined as imports - exports ± adjustments for Government and industry stock changes.
7/ See page 182 for definitions.
8/ Excludes Centrally Planned Economies.

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7. Government Stockpile: In addition to quantities shown below, the stockpile contains 869,000 pounds in nonstockpile-grade columbium concentrate and 333,000 pounds in nonstockpile-grade ferrocolumbium. Some 213,000 pounds of columbium contained in tantalum minerals, contracted for in late 1983 and early 1984 by the General Services Administration, were delivered and recorded as columbium stockpile inventory.

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Columbium:				
Carbide powder	100	21	-	-
Concentrate	5,600	1,150	-	-
Ferrocolumbium	-	598	-	-
Metal	-	45	-	-

8. Events, Trends, and Issues: First quarter overall reported consumption of columbium was up slightly, by 2%, from that of the previous year. For the same period, demand for columbium in superalloys was up over 10%, that portion used in the form of nickel columbium increasing by more than 45%. Imports of both columbium concentrates and ferrocolumbium were down from the 1984 levels. The published price of Canadian pyrochlore remained at $3.25 per pound of contained pentoxide, and the spot columbite price remained at $3.50 to $5.00 per pound of combined columbium and tantalum pentoxides. Also, the published spot price of steelmaking-grade ferrocolumbium and high-purity ferrocolumbium remained unchanged at $5.60 and $17.70 per pound of contained columbium, respectively.

From a 1983 base, demand for columbium is expected to increase at an average annual rate of about 5% through 1990. It is estimated that in 1986 domestic mine production of columbium will be zero and U.S. apparent consumption will be 8 million pounds.

There are no known uncontrollable health hazards connected with production or fabrication of columbium metals and compounds. Fumes, gases, dust, and low-level radiation generated by columbium-processing plants can be controlled by modern technology.

9. World Mine Production and Reserve Base:

	Mine Production e/ 1984	Mine Production e/ 1985	Reserve Base 7/
United States	-	-	Negligible
Brazil	23,140	24,000	8,000,000
Canada	4,330	4,900	700,000
Nigeria	100	100	200,000
Zaire	30	30	200,000
Other Market Economy Countries	322	350	19,000
Centrally Planned Economies	NA	NA	NA
World Total (may be rounded) 8/	27,922	29,000	9,100,000

10. World Resources: Most of the world's identified resources of columbium lie outside the United States and occur mainly as pyrochlore in carbonatite deposits. On a worldwide basis, resources are more than adequate to supply projected needs. The United States has approximately 800 million pounds of columbium resources located in identified deposits, which were considered uneconomic at 1985 prices for columbium.

11. Substitutes: The following materials can be substituted for columbium, but a performance or cost penalty may ensue: Vanadium and molybdenum in high-strength low-alloy steels; tantalum and titanium in stainless and high-strength steel and superalloys; and molybdenum, tungsten, tantalum, and ceramics in high-temperature applications.

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COPPER

(Data in thousand metric tons of copper content, unless noted)

1. Domestic Production and Use: Domestic mine production in 1985 was 1.0 million tons, valued at $1.5 billion. The principal mining States were Arizona, New Mexico and Utah, but eight other States also yielded copper. Twenty-three mines accounted for 99% of the estimated 1985 mine production. Eight primary and 7 secondary smelters, 6 primary and 8 secondary refineries and 7 electrowinning plants were operating at yearend. Copper was fabricated at 20 wire rod mills and 40 brass mills. Copper consumption 1/ in 1985, by industrial sector was: Building construction, 39%; electrical and electronic products, 25%; industrial machinery and equipment, 15%; transportation, 11%; and consumer and general products, 10%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Mine	1,538	1,147	1,038	1,091	1,050
Refinery: Primary 2/	1,544	1,227	1,182	1,200	1,125
Secondary 3/	494	468	402	309	310
Copper from old scrap, all sources	598	518	450	465	450
Imports for consumption: Ores and Concentrates	39	118	91	9	2
Refined	331	258	460	445	390
All imports	438	513	634	531	460
Exports: Ores and Concentrates	151	195	50	53	175
Refined	24	31	81	91	45
All exports	303	345	239	286	480
Consumption: Refined, reported	2,025	1,658	1,804	2,036	1,965
Apparent, total 4/	2,277	1,761	2,014	2,155	2,166
Price, average, cents per pound:					
Domestic producer cathode	84.2	72.8	76.5	66.8	66.9
London Metal Exchange, high grade	79.4	67.1	72.1	62.4	64.2
Stocks, yearend, refined 5/	465	676	672	536	290
Employment, mine and mill	30,600	20,600	14,700	12,700	10,000
Net import reliance 6/ as a percent of apparent consumption	6	1	19	23	27

3. Recycling: Old scrap, converted to refined metal and alloys, provided 450,000 tons of copper, or 21% of apparent consumption. New scrap, derived from fabricating operations, yielded 647,000 tons of contained copper. Of the total copper recovered from scrap, smelters and refiners recovered 46%, brass mills, 41%, and miscellaneous manufacturers, foundries and chemical plants, 13%. About 28% was recovered as refined copper. Seventy percent of the copper contained in new scrap was recovered at brass mills.

4. Import Sources (1981-84): Chile 39%, Canada 25%, Peru 9%, Mexico 7%, Other 20%.

5. Tariff: Of the major import sources in 1985, under special tariff rates, certain articles from Mexico and Peru were duty free.

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Black copper, blister, anode	612.03	1.1% on the value of copper content	1.0% on the value of copper content	6.0% ad val.
Refined, unwrought	612.06	1.0% ad val.	1.0% ad val.	6.0% ad val.
Waste and scrap	612.10	0.2% ad val.	Free	6.0% ad val.

e/ Estimated.
1/ Copper used in electrical components in each end use is distributed among industrial sectors.
2/ From domestic and imported materials.
3/ From new and old scrap, at primary and secondary refineries.
4/ Defined as primary refined production + copper refined from old scrap + copper recovered in alloys from old scrap + refined imports - refined exports ± changes in refined stocks.
5/ Held by refineries, mills, miscellaneous manufacturers and by Commodity Exchange Inc.
6/ Defined as imports - exports ± adjustments for Government and industry stock changes.
7/ See page 182 for definitions.

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6. Depletion Allowance: 15% (Domestic), 14% (Foreign).

7. Government Stockpile:

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Copper	907	20	-	-

8. Events, Trends, and Issues: Changes in ownership of mine and copper producing plants continued during the year. The new ownership included some acquisitions by foreign firms and employee-based partnerships as companies moved to improve their financial status and production costs. Several mines were being allowed to flood, removing an additional 134,000 tons per year of copper mine capacity from immediate access. A mine in Michigan that had been closed since 1982 reopened in late 1985, while early in the year the largest mine in the United States closed, in addition to several other mine and plant closures. Even so, several firms reported profits during the year for the first time since 1981, a benefit of technical improvements and labor concessions. Copper prices continued at depressed levels, despite a slight improvement in consumption and the reduction of inventories to near 1980 levels by yearend. The U.S. import reliance for refined copper was at a record high, despite the drop-off in refined copper imports. This could be attributed to the drawdown of inventories from COMEX instead of increased imports. Exports of copper in scrap and concentrates increased significantly during the year, largely as a result of slowdown in domestic brass mill and copper smelter activity. The high cost of environmental compliance continued to concern the domestic smelter industry. A significant increase in low-priced imports of manufactured and semimanufactured copper articles also impacted domestic brass mills and ingot makers. Effects of the strong U.S. dollar continued to be a problem for most of the industry.

Apparent consumption of refined copper by U.S. fabricators was highest early in 1985, and moderated considerably in the second half of the year. The electronics market for U.S. brass mills was particularly impacted by a drop in demand, foreign competition, and a surplus of capacity. It is estimated that in 1986 U.S. apparent consumption for refined copper will be 2.2 million tons and that domestic mine production will be maintained at about 1.1 million tons. From a 1983 base, demand for copper in the United States is expected to increase at an average annual rate of 1.9% through 1990.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 7/
	1984	1985 e/	
United States	1,091	1,050	90,000
Australia	236	275	41,000
Canada	712	710	23,000
Chile	1,290	1,290	97,000
Peru	364	400	32,000
Philippines	226	220	18,000
Zaire	540	540	30,000
Zambia	540	475	34,000
Other Market Economy Countries	1,433	1,430	100,000
Poland	360	355	15,000
U.S.S.R. e/ (data series revised)	590	600	36,000
Other Centrally Planned Economies	456	460	9,000
World Total	7,838	7,805	525,000

10. World Resources: Land-based resources are estimated at 1.6 billion tons of copper and resources in deep sea nodules at 0.7 billion tons. About 85% of the land-based resource is located in the market economy countries.

11. Substitutes: Other materials may substitute for copper in some applications, such as aluminum in electrical equipment, automobile radiators, and refrigerator tubing, titanium and steel in heat exchangers, steel in shell casings, optical fiber in telecommunications cable, and plastics in water pipe and plumbing fixtures.

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CORUNDUM, ABRASIVE (NATURAL)

(Data in short tons of corundum, unless noted)

1. Domestic Production and Use: There has been no reported sustained production of abrasive-grade corundum since 1906. In recent years the domestic supply has consisted almost entirely of material imported by one firm in Massachusetts. In 1985, another firm, also in that State, accounted for one-fourth of domestic consumption. Corundum was used in grinding and polishing optical components, 40%; tumbling media, 25%; fabricated metal products, 20%; and other, 15%. U.S. processed corundum consumption was valued at $600,000.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production			None		
Imports for consumption 1/			Not available		
Exports 2/			Not available		
Consumption, apparent 3/	1,100	650	725	410	400
Price, average value, dollars per ton:					
Crude			Not available		
Processed	1,500	1,540	1,540	1,540	1,540
Stocks, yearend	2,756	2,100	1,375	965	565
Employment, mill	10	7	7	7	7
Net import reliance 4/ as a percent of apparent consumption	100	100	100	100	100

3. Recycling: None.

4. Import Sources (1981-84): 1/ None.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Emery, corundum, pumice in blocks 5/	519.1500	Free	Free	Free
Corundum, natural, crude or crushed	519.1720	Free	Free	Free
Natural corundum, artificial aluminum oxide, ground, pulverized, refined	519.3740	Free	Free	Free
Abrasive articles, natural corundum or other artificial abrasive, materials, n.s.p.f.	519.9500	Free	Free	20% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated.
1/ The most recent shipment, 4,867 tons, of corundum was imported from the Republic of South Africa in 1979 and accounted for 100% of the imports for that year.
2/ Export data are not available and are assumed to be zero for apparent consumption and net import reliance calculations.
3/ Apparent consumption is based on the major importer's estimate. Demand in 1980-85 was supplied from stocks.
4/ Defined as imports - exports + adjustments for Government and industry stock changes.
5/ Block pumice thought to be negligible.
6/ See page 182 for definitions.

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8. Events, Trends, and Issues: Demand for abrasive-grade natural corundum since 1979 has been met by withdrawal from stocks. The United Nations embargo on corundum was removed in 1979 upon the establishment of an independent Zimbabwe. However, the United States has not imported corundum from Zimbabwe directly since 1968. From a 1983 base, demand for corundum is expected to decrease at an average annual rate of about 1.4% through 1990. The primary cause for the continuing decrease in demand has been the increased use of plastics that do not require grinding and polishing for optical components, especially eyeglass lenses, which had been the largest market for abrasive-grade corundum. It is estimated that in 1986 U.S. apparent consumption of corundum will be 400 tons.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 6/
	1984	1985 e/	
United States	-	-	None
India	550	500	Small
South Africa, Republic of	70	-	Large
Zimbabwe	-	-	Moderate
Other Market Economy Countries	1,300	1,300	Large
Centrally Planned Economies	8,000	8,300	Large
World Total (rounded)	9,920	10,100	

10. World Resources: Abrasive-grade corundum occurs in the United States in South Carolina, North Carolina, Georgia, Colorado, Montana, and Nevada. These resources are not well defined and are probably very small. The principal resources are in Zimbabwe, the Republic of South Africa, and the U.S.S.R. Corundum has also been found in other countries but the deposits have not been thoroughly evaluated.

11. Substitutes: Alternate competitive abrasives are boron carbide, cubic boron nitride, diamond, fused aluminum oxide (sometimes called electrocorundum), garnet, and silicon carbide.

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DIAMOND (INDUSTRIAL)

(Data in million carats, unless noted)

1. Domestic Production and Use: Synthetic diamond production, exports and imports maintained their high levels achieved in 1984. All industrial diamond produced domestically was synthetic grit in sizes suitable for use in saws, machine tools, drill bits, grinding wheels, and grinding and polishing, and was the output of five firms, one each in New Jersey, Ohio, and Michigan and two in Utah. Six firms recovered and sold industrial diamond as the principal product. About 50 firms recovered industrial diamond in secondary operations and the majority of these diamonds were either credited to the clients' account or reset in their bits or tools. Major uses of all industrial diamond were: Machinery, 27%; mineral services, 18%; stone and ceramic products, 17%; abrasives, 16%; contract construction, 13%; transportation equipment, 6%; and other, 3%. U.S. consumption was valued at about $134 million. The mineral services industry, primarily drilling, accounted for 74% of stone consumption.

2. Salient Statistics--United States: 1/

	1981	1982	1983	1984	1985 e/
Bort, grit, and powder and dust, natural and synthetic:					
Production: Manufactured diamond	57.0	53.0	69.0	76.0	76.0
Secondary e/	1.8	1.2	1.2	1.5	1.5
Imports for consumption	14.4	14.3	18.8	35.2	34.5
Exports: Including reexports 2/	28.5	30.6	42.3	48.0	52.1
In manufactured products e/	0.7	0.5	0.5	0.5	0.6
Sales of Govt. stockpile excesses	-	1.5	0.2	-	-
Consumption, apparent	44.0	38.9	46.2	65.2	59.3
Price, value of imports, dollars per carat	1.91	1.90	1.49	1.33	1.35
Net import reliance 3/ as a percent of apparent consumption			Net exporter		
Stones, natural:					
Production: Mine			None		
Secondary e/ 4/	0.5	0.5	0.6	0.7	0.7
Imports for consumption	6.0	4.7	6.1	8.3	9.1
Exports and reexports 2/	2.3	1.9	3.2	3.3	3.2
In manufactured products e/	0.5	0.4	0.3	0.5	0.5
Sales of Govt. stockpile excesses 4/	1.5	1.2	1.0	1.5	1.5
Consumption, apparent	3.7	2.9	3.2	4.2	6.1
Price, value of imports, dollars per carat	13.93	12.60	9.98	8.35	8.84
Net import reliance 3/ as a percent of apparent consumption:	100	100	100	100	100

3. Recycling: About 2.2 million carats were salvaged in secondary production from salvage stone, sludge, and swarf.

4. Import Sources (1981-84): Bort, grit, and powder and dust, natural and synthetic: Ireland 64%, Japan 8%, Republic of South Africa 8%, United Kingdom 4%, Other 16%.
Stone, natural: Republic of South Africa 61%, Ireland 9%, Zaire 9%, United Kingdom 8%, Belgium-Luxembourg 5%, Other 8%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Synthetic diamond, other	520.21	3.6% ad val.	3.0% ad val.	30.0% ad val.
Miners' diamond, synthetic/natural	520.19,520.23	Free	Free	Free
Crushing bort	520.27	Free	Free	Free
Powder or dust, synthetic/natural	520.20,520.28	Free	Free	Free
Other: Not advanced in condition	520.29	Free	Free	Free

e/ Estimated.
1/ Industry stocks and employment were unknown.
2/ Excluding diamonds in manufactured abrasive products.
3/ Defined as imports + secondary - exports including reexports + adjustments for Government and industry stock changes.
4/ Diamond stones sold from the Govt. stockpile excesses were apparently exported to Belgium as gem-quality diamond; consequently, they were excluded from the apparent consumption calculations.
5/ Natural industrial diamond only.
6/ See page 182 for definitions.

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6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: On July 8, 1985, the Administration announced that the President had proposed new National Defense Stockpile goals. By December 1, the proposal was still being considered by Congress.

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Crushing bort	22.0	22.0	-	0.0
Industrial stones	7.7	13.1	6.3	1.5

8. Events, Trends, and Issues: From a 1983 base, demand for industrial diamond is expected to increase at an average annual rate of 4.7% through 1990. It is estimated that in 1986 U.S. apparent consumption of industrial diamond will be 55 million carats. The Wyoming Geological Survey and two mining companies independently continued diamond exploration near the Colorado-Wyoming border. One company identified a low grade diamond resource that averaged 0.005 to 0.01 carats per ton. Development of the Argyle open cast lamproite pipe mine in Western Australia continued on schedule and within budget. Annual production of the $550 million venture was projected to be 25 million carats and the project was scheduled for completion by the end of 1985. The Argyle alluvial deposits, placed in production in 1983, experienced an anticipated decline in output because of depletion of the higher grade material. Domestic diamond synthesis in 1985 was more than adequate for the smaller sizes. However, synthesis of larger industrial diamond was not commercial; hence, the United States was dependent on imports of stones or sales of Government stockpile excesses. Prices for the smaller sizes have decreased as a result of competition between domestic synthetic diamond and imports of natural and synthetic diamond. Prices for larger sizes decreased since 1981 because demand for new imported stones declined while the bit and tool manufacturers attempted to reduce a large inventory accumulation, especially in the mineral services sector, and because of increased competition from synthetic polycrystalline diamond compacts and shapes.

9. World Mine Production and Reserve Base 5/:

	Production		Reserve Base e/ 6/
	1984	1985 e/	
United States	-	-	Unknown
Australia	3.1	2.8	500
Botswana	7.1	7.0	125
Brazil	0.9	0.9	15
South Africa, Republic of	5.6	5.6	70
Zaire	13.3	13.3	150
Other Market Economy Countries	1.0	1.0	30
China	0.8	0.8	20
U.S.S.R.	6.4	6.4	80
World Total	38.2	37.8	990

10. World Resources: The potential for discovery of resources of diamond in the United States has improved. However, evaluation of deposits already discovered will take several more years. Technology has been developed to synthesize diamond for industrial use worldwide in the range of sizes of crushing bort, powder, and dust. World resources of natural industrial diamond in the stone-size range are unknown.

11. Substitutes: Competitive materials were cubic boron nitride, fused aluminum oxide, and silicon carbide as manufactured abrasive materials; and garnet, emery, and corundum as natural abrasive minerals. Synthesized polycrystalline diamond was competitive with natural stones in some applications. Research continued on additional uses of synthetic polycrystalline compacts and shapes as substitutes for stones.

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DIATOMITE

(Data in thousand short tons, unless noted)

1. **Domestic Production and Use:** The estimated value of processed diatomite, f.o.b. plant, was $133 million in 1985. Seven companies with nine processing facilities in four States produced diatomite. California was the principal producing State and accounted for more than 50% of production. End uses of diatomite were: Filter aid, 67%; fillers, 22%; and other, 11%.

2. **Salient Statistics--United States:**

	1981	1982	1983	1984	1985 e/
Production, mine 1/	687	613	619	627	637
Imports for consumption	2/	2/	2/	2/	2/
Exports	162	141	146	127	120
Consumption, apparent	525	472	473	500	517
Price, average value, dollars per ton, f.o.b. plant	164.50	175.56	185.00	193.00	209.00
Stocks, producer, yearend	36	36	36	36	36
Employment, mine and plant e/	950	900	900	900	900
Net import reliance 3/ as a percent of apparent consumption			Net exporter		

3. **Recycling:** None.

4. **Import Sources (1981-84):** Mexico 75%, Other 25%.

5. **Tariff:**

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Crude or processed	522.11	Free	Free	Free

6. **Depletion Allowance:** 14% (Domestic), 14% (Foreign).

7. **Government Stockpile:** None.

e/ Estimated. NA Not available.
1/ Processed ore sold or used by producers.
2/ Less than 500 tons.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ See page 182 for definitions.
5/ Estimated diatomite content of moler production.

Prepared by A. C. Meisinger, telephone number (202) 634-1185.

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8. Events, Trends, and Issues: The United States remained the largest producer and consumer of diatomite and exported processed diatomite to more than 50 countries, primarily for filtration use. From a 1983 base, demand for diatomite is expected to increase at an average annual rate of about 3% through 1990. It is estimated that in 1986 domestic mine production of processed diatomite will be 650,000 tons and U.S. apparent consumption will be 525,000 tons.

   All domestic mining is by open pit and conflicting land-use problems exist. Control of dust in mining is adequate due to the high moisture content of the crude ore. Almost all processing is enclosed to permit effective control of silica dust.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 4/
	1984	1985 e/	
United States	627	637	500,000
Brazil	18	20	2,000
Denmark 5/	143	145	NA
France	240	240	2,000
Germany, Federal Republic of	49	50	NA
Iceland	28	30	2,000
Korea, Republic of	60	60	NA
Mexico	50	50	NA
Spain	60	60	NA
Other Market Economy Countries	80	80	NA
Centrally Planned Economies	310	310	NA
World Total (may be rounded)	1,665	1,680	2,000,000

10. World Resources: World resources of crude diatomite are adequate for the foreseeable future, but the need for diatomite near markets encourages development of new sources for the material.

11. Substitutes: Many alternate materials can be substituted for diatomite; however, the unique properties of diatomite assure a continuing acceptance for many applications. Expanded perlite, asbestos, and silica sand compete for filtration purposes although, in most instances, diatomite is a superior material. Alternate filler materials include talc, ground silica sand, ground mica, clay, perlite, vermiculite, and ground limestone. For thermal insulation, materials such as brick, clay, asbestos, mineral wool, expanded perlite, and exfoliated vermiculite can be used.

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FELDSPAR

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: U.S. feldspar production in 1985 had an estimated value of $24 million. The three largest producers accounted for about 70% of the output, and the next three jointly supplied 20%. North Carolina provided 70% of the 1985 output, and five other States contributed smaller quantities.

   Production of lithium ores and mica yielded moderate quantities of byproduct or coproduct feldspar in 1985, and feldspar processors reported coproduct recovery of mica and silica sand.

   Feldspar is ground for use in industry to about 20 mesh for glassmaking and to 200 mesh or finer for most ceramic and filler applications. Major shipments went to Georgia, Illinois, New Jersey, Ohio, Pennsylvania, and Texas, with lesser amounts going to at least 25 other States and foreign destinations, especially Canada and Mexico. In ceramics and glass, feldspar functions principally as a flux. Estimated 1985 end-use distribution of domestic feldspar was: Glass, 55%; pottery, 41%; porcelain enamel and miscellaneous applications, 4%.

2. Salient Statistics—United States:

	1981	1982	1983	1984	1985 e/
Production, marketable	665	615	710	710	700
Imports for consumption	1/	1/	1/	1/	1/
Exports	14	11	9	10	11
Consumption, apparent	651	604	701	700	689
Price, average, dollars per ton	31.60	33.00	31.70	33.10	34.30
Stocks, producer, yearend		Not available			
Employment, mine and preparation plant	450	450	450	450	450
Net import reliance 2/ as a percent of apparent consumption		Net exporter			

3. Recycling: Insignificant.

4. Import Sources (1981-84): Canada 42%, Sweden 25%, Japan 15%, Other 18%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Crude	522.31	Free	Free	50¢/long ton
Ground	522.41	2.9% ad val.	2.8% ad val.	30% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated.
1/ Less than 1/2 unit.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 182 for definitions.

Prepared by M. J. Potter, telephone number (202) 634-1180.

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8. Events, Trends, and Issues: U.S. mine production of feldspar was about the same as the average of the preceding decade (1975-1984). Housing construction in 1985 continued at a fairly good level of activity, as did the use of feldspar in plumbing fixtures, tile, and glass fiber for insulation. Feldspar use in glass containers has decreased in recent years because of competition from plastic containers. From a 1984 base, demand for feldspar is expected to increase at an average annual rate of about 1% through 1990. It is estimated that in 1986 domestic mine production of feldspar will be 720,000 tons and U.S. apparent consumption will be 710,000 tons. Use in glassmaking, feldspar's largest outlet, has been slowed since the 1950's by competition from imported nepheline syenite. High transportation costs continued to be a significant factor facing the feldspar industry.

   Imports of nepheline syenite in 1985 were an estimated 340,000 tons, or 10% less than in 1984.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 3/
	1984	1985 e/	
United States	710	700	
Brazil	165	165	
France	193	190	Large in the
Germany, Federal Republic of	369	370	United States and
Italy	959	960	assumed to be
Mexico	132	130	large in other
Spain	127	130	countries.
Other Market Economy Countries	842	840	
U.S.S.R. e/	360	360	
Other Centrally Planned Economies	154	155	
World Total	4,011	4,000	

10. World Resources: Identified and hypothetical resources of feldspar are more than adequate to meet anticipated world demands. Quantitative data on hypothetical resources of feldspar existing in granites, pegmatites, and feldspathic sands have not been compiled. There is ample geologic evidence that resources are immense although not always conveniently accessible from the principal centers of consumption.

11. Substitutes: Feldspar can be replaced in some of its end uses by feldspar-silica mixtures, clays, talc, pyrophyllite, spodumene, or electric-furnace slag. Imported nepheline syenite, however, was the major alternate material.

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FLUORSPAR

(Data in thousand short tons, unless noted)

1. **Domestic Production and Use:** Four companies in three States shipped an estimated 70,000 tons of fluorspar in 1985. Two producers in southern Illinois accounted for over 90% of domestic output. Small shipments from Nevada and Texas accounted for the remainder. Barite and zinc concentrates were the main coproducts of fluorspar mining and milling.

   Approximately 70% of the fluorspar consumed in the United States in 1985 went into the manufacture of hydrofluoric acid, a key ingredient in the aluminum, fluorochemical, and uranium industries. About 26% was consumed by steelmakers. The remainder was consumed in glass manufacture, welding rod coatings, enamels, and other end uses or products. Supplementing domestic supplies of fluorine were about 63,000 tons of fluosilicic acid (equivalent to 110,000 tons of fluorspar) recovered from 16 phosphoric acid plants processing phosphate rock and 2 plants producing hydrofluoric acid. About 60% of the fluosilicic acid was used in water fluoridation directly or to produce sodium silicofluoride; 25% was used to make chemicals for smelting primary aluminum; the remaining 15% was used for miscellaneous purposes.

2. **Salient Statistics--United States:**

	1981	1982	1983	1984	1985 e/
Production: Finished (all grades) 1/	115	77	e/ 61	e/72	70
Fluorspar equivalent from phosphate rock	75	64	117	107	110
Imports for consumption:					
Acid-spar	571	408	385	521	500
Met-spar	256	136	68	182	110
Fluorspar equivalent from hydrofluoric acid plus cryolite	167	162	146	199	200
Exports, ceramic and acid grades	11	11	9	12	11
Consumption: Apparent 2/	898	618	614	743	719
Reported: Acid-spar	551	327	382	547	500
Met-spar 3/	382	203	182	206	170
Price, yearend: 4/ Acid-spar, dollars per ton	171	180	180	173	173
Met-spar, dollars per ton	110	110	125	125	125
Stocks, yearend: Mine (Finished)	13	11	W	W	W
Consumer	216	208	99	120	70
Employment, mine and mill e/	400	300	300	300	300
Net import reliance 5/ as a percent of apparent consumption	87	90	90	90	90

3. **Recycling:** Increasing quantities of fluorides were being recycled annually in the aluminum industry. There is no recycling in other consuming industries.

4. **Import Sources (1981-84):** Mexico 50%, Republic of South Africa 29%, China 8%, Italy 7%, Other 6%.

5. **Tariff:**

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Acid grade (more than 97% CaF_2)	522.21	$2.10/long ton	$2.10/long ton	$5.60/long ton
Metallurgical grade (less than 97% CaF_2)	522.24	13.5% ad val.	13.5% ad val.	13.5% ad val.

6. **Depletion Allowance:** 22% (Domestic), 14% (Foreign).

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
1/ Shipments.
2/ Excludes fluorspar equivalent of fluosilicic acid, hydrofluoric acid, and cryolite.
3/ Includes fluorspar briquets.
4/ Fluorspar prices, f.o.b. Illinois, are quotations from Engineering and Mining Journal.
5/ Defined as imports - exports + adjustments for Government and industry stock changes.
6/ See page 182 for definitions.
7/ Measured as 100% calcium fluoride.

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7. Government Stockpile: In addition to the quantity shown below, the stockpile contains 899 tons of nonstockpile acid-grade material and 116,863 tons of nonstockpile metallurgical-grade material.

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Acid grade	1,400	895	-	-
Metallurgical grade	1,700	295	-	-

8. Events, Trends, and Issues: Domestic production was essentially unchanged from that of 1984. Large-scale production of fluorspar in the Western States continued to be uneconomic because high freight rates to the Midwestern and gulf coast consuming areas made domestic fluorspar and its products less competitive with those of foreign suppliers.

Fluorspar demand was also near 1984 levels but with consumption by steelmakers decreasing and that by the chemical industry increasing. From a 1983 base, demand for fluorspar equivalent is expected to increase at an average annual rate of about 2.7% through 1990. It is estimated that in 1986, domestic mine production of fluorspar will be 70,000 tons and U.S. apparent consumption will be 750,000 tons. Estimated fluosilicic acid production in 1986 is expected to be 60,000 tons, which is equivalent to approximately 106,000 tons of acid-grade fluorspar.

The average value of domestically produced fluorspar in 1985 was withheld to avoid disclosing company proprietary data. The average reported value of fluorspar entering U.S. ports was $98.00 per ton for acid grade and $62.75 for fluorspar containing not more than 97% calcium fluoride.

9. World Mine Production and Reserve Base:

	Production		Reserve Base 6/ 7/
	1984	1985 e/	
United States	72	70	37,000
France	215	250	10,000
Italy	209	210	8,000
Kenya	55	60	3,000
Mexico	771	750	24,000
South Africa, Republic of	354	380	41,000
Spain	265	270	10,000
Thailand	242	300	2,000
United Kingdom	176	200	3,000
Other Market Economy Countries	335	350	10,000
China	716	700	25,000
Mongolia e/	772	770	65,000
U.S.S.R. e/	606	600	104,000
Other Centrally Planned Economies	282	300	20,000
World Total	5,070	5,210	362,000

10. World Resources: Identified world fluorspar resources amount to approximately 450 million tons of contained fluorspar. Resources of equivalent fluorspar from domestic phosphate rock are approximately 35 million tons. World resources of fluorspar from phosphate rock are estimated to be 360 million tons.

11. Substitutes: Olivine or dolomitic limestone were being used as substitute fluxes for fluorspar. Gaseous hydrocarbons and carbon dioxide have been substituted for chlorofluorocarbons as aerosol propellants.

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GALLIUM

(Data in kilograms of gallium content, unless noted)

1. Domestic Production and Use: One domestic firm recovered gallium and germanium from previously mined material left from a closed copper mining operation near St. George, UT. Another company in Quapaw, OK, recovered and refined gallium from scrap. Over 90% of the gallium consumed was in the form of gallium compounds that were used in electronic applications, including semiconductors, light emitting diodes, and lasers. These devices were incorporated into computers, fiber optic communication systems, and machine controls.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, refinery		Not available			
Imports for consumption	5,536	5,199	7,294	9,669	8,000
Exports		Not available			
Consumption: Reported	6,810	6,660	6,425	7,060	7,500
Apparent		Not available			
Price, dollars per kilogram	630	630	525	525	525
Stocks, producer, yearend		Not available			
Employment, refinery e/	20	20	20	20	20
Net import reliance 1/ as a percent of apparent consumption		Not available			

3. Recycling: Old scrap, none. Substantial quantities of new scrap generated in the manufacture of solid state semiconductor devices were reprocessed.

4. Import Sources (1981-84): Switzerland 48%, Federal Republic of Germany 17%, France 15%, China 7%, Other 13%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Gallium compounds	423.00	[illegible] ad val.	3.7% ad val.	25.0% ad val.
Gallium metal	632.24	[illegible]% ad val.	3.7% ad val.	25.0% ad val.

6. Depletion Allowance: Not applicable.

7. Government Stockpile: None.

e/ Estimated.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.

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8. Events, Trends, and Issues: Recovery of crude gallium from previously mined material from a closed copper mining operation began late in the year at a facility in Utah. Development continued on the ore zone, which reportedly contains recoverable quantities of copper, zinc, and silver as well as gallium and germanium. This is the only operation in the world that recovers gallium or germanium as principal products, and, when fully operational, the plant's annual production capacity is expected to be 10,000 kilograms of gallium and 17,900 kilograms of germanium. However, in 1985 imports continued to provide most of the supply needed to meet the domestic gallium demand. From a 1983 base, demand for gallium is expected to increase at an average annual rate of about 10% through 1990. New semiconductor devices based on gallium arsenide technology were introduced in 1985, and research and development continued on the properties, fabrication techniques, and uses of gallium compounds. Several domestic companies announced plans to construct new facilities for gallium arsenide processing or expand existing processing capacities.

   A company in Japan announced that it was doubling its primary gallium recovery capacity to 10,000 kilograms per year by the end of 1986, in response to increased demand for gallium in semiconductor applications.

   Gallium metal and compounds are considered relatively nontoxic. There are no known environmental constraints on the recovery and use of gallium; however, environmental constraints are placed on arsenic, which may be recovered from gallium arsenide scrap.

9. World Mine Production and Reserve Base: Data on U.S. and world production of gallium were unavailable because data on the output of the few producers was considered to be proprietary. However, in 1985 world primary production was estimated to be about 30,000 kilograms with France, Federal Republic of Germany, and Japan as the largest producing countries. Countries with smaller output were China, Czechoslovakia, Hungary, and the United States.

   Gallium occurs in very small concentrations in many rocks and ores of other metals. Most of it was produced as a byproduct of treating bauxite, and the remainder was produced from residues from zinc processing.

   Only part of the gallium present in bauxite and zinc ores was recoverable, and the factors controlling the recovery were proprietary. Therefore, a meaningful estimate of current reserves could not be made. The world bauxite reserve base is so large that much of it will not be mined for many decades; hence, most of the gallium in it can be considered to have only long-term availability.

10. World Resources: On the assumption that the average content of gallium in bauxite is 50 ppm, about 2 million kilograms of this metal are present in the bauxite reserves in Arkansas. The gallium in U.S. bauxite resources, which are mainly subeconomic deposits, is approximately 15 million kilograms. Some domestic zinc ores contain as much as 50 ppm gallium and, as such, could be a significant resource. World resources of gallium in bauxite are estimated to exceed 1 billion kilograms, and a considerable quantity could be present in world zinc reserves. The foregoing estimates apply to total gallium content; only a small percentage of this metal in bauxite and zinc ores is economically recoverable.

11. Substitutes: Liquid crystals made from organic compounds are used in visual display panels as substitutes for light-emitting diodes. Silicon and germanium are alternate materials for gallium in many semiconductor applications.

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GARNET, INDUSTRIAL 1/
(Data in short tons of garnet, unless noted)

1. Domestic Production and Use: Garnet was supplied in 1985 by four firms, two in New York, one in Idaho, and one in Maine. Output was valued at $6.0 million. The end uses for garnet were: abrasives in transport manufacturing, 50%; water filtration, 30%; finishing wood furniture, 10%; electronic components, 7%; and ceramics and glass, 3%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production	25,451	27,303	29,767	29,647	36,200
Sold by producers	25,519	26,660	30,300	27,672	32,600
Imports for consumption			None		
Exports e/	3,270	3,400	3,200	3,400	3,200
Consumption, apparent	22,250	23,260	27,100	24,272	29,400
Price, range of value, dollars per ton:	120-1,200	120-1,200	120-1,200	70-1,200	100-1,200
Stocks e/	6,291	6,934	6,401	8,376	11,976
Employment, mine and mill	115	120	130	130	120
Net import reliance 2/ as a percent of apparent consumption			Net exporter		

3. Recycling: None.

4. Import Sources (1981-84): None.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Other abrasives, emery, corundum, pumice, flint, rottenstone, garnet, in grains or ground, pulverized, or refined	519.3760	0.3¢/lb	0.3¢/lb	1.0¢/lb
Papers, cloths, etc., wholly or partly covered with abrasives, artificial or natural, in sheets, strips, belts, etc.	519.5100	2.7% ad val.	2.5% ad val.	20% ad val.
Abrasive articles, n.s.p.f, other, of emery or garnet	519.9100	4.2% ad val.	3.7% ad val.	20% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated.
1/ Excludes gem and synthetic garnet.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 182 for definitions.

Prepared by Jean W. Pressler, telephone number (202) 634-1206.

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8. Events, Trends, and Issues: From a 1983 base, demand for garnet is expected to increase at an average annual rate of about 2% through 1990. It is estimated that in 1986 domestic mine production will be 30,000 tons and U.S. apparent consumption will be 27,000 tons. The environmental effects of garnet mining are minor. Tailings from the quarrying operations in New York were used within the quarry property for fill and road maintenance. In Idaho, the land was restored after placer mining of the garnet-bearing gravel. Tailings from the quarrying operations in Maine were sold as a utility grit for nonskid surfaces and as a one pass silica-free airblasting medium.

   Construction of a new almandine garnet alluvial processing plant has been completed in Geraldton, Western Australia. The plant will produce a range of grits for coated abrasives, and powders for a wide variety of polishing applications in addition to the normal range of garnet for blast cleaning and water filtration.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 3/
	1984	1985 e/	
United States	29,647	36,200	25,000,000
Australia	4,000	4,000	7,000,000
India	6,000	6,000	10,000,000
Other Market Economy Countries	100	100	10,000,000
China	3,000	3,000	Moderate to Large
U.S.S.R.	1,000	1,000	10,000,000
World Total (may be rounded)	43,747	50,300	Large

10. World Resources: Garnets occur in a large variety of rocks all over the world, more particularly in gneisses and schists. They also occur as contact-metamorphic deposits in crystalline limestones, pegmatites, and serpentinites, and in high-temperature intrusive contacts and vein deposits. Alluvial garnet is also a coproduct with many heavy mineral sand and gravel deposits in the world. Large domestic resources of garnet are concentrated in coarsely crystalline gneiss in the vicinity of North Creek, NY. One of the world's largest known garnet deposits is being quarried in Rangley County, ME. The medium grained ore from this deposit has an unusually high garnet concentration of 50% to 60%. Significant resources of garnet occur also in Idaho, New Hampshire, and North Carolina. World resources of garnet are large.

11. Substitutes: Garnet is competitive in abrasive applications with natural and manufactured abrasives such as diamond, cubic boron nitride, fused aluminum oxide, and silicon carbide, quartz sand, and in water filtration with ilmenite, magnetite, and plastics.

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GEM STONES 1/
(Data in million dollars)

1. Domestic Production and Use: Output of gem stones was primarily from Arizona, 36%, and Nevada, 18%. It was estimated that 66,500 visitors found 830 diamonds in the Crater of Diamonds State Park in Park County, AR. There was considerable production of tourmaline and kunzite from San Diego County, CA. In Emerald Creek, ID, 887 permits were issued to diggers, who found 840 pounds of gem garnet, most of which was asteriated. Collection of gem materials was mainly by individuals for recreation. Major uses were jewelry, mineral collections, and industrial.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Mine e/	7.6	7.2	7.4	7.5	7.4
Imports for consumption	2,766	2,384	2,856	3,652	3,400
Exports, including reexports	958	749	731	681	680
Consumption, apparent	1,816	1,642	2,132	2,979	2,727
Price	Variable, depending on size, type, and quality				
Stocks, yearend	Not available				
Employment: Mine 2/	190	200	200	200	200
Net import reliance 3/ as a percent of apparent consumption	100	100	100	100	100

3. Recycling: Insignificant.

4. Import Sources (1981-84 by value) 4/: Belgium-Luxembourg 30%, Israel 23%, India 17%, Republic of South Africa 15%, Other 15%. Diamond imports were about 80% of total imports.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Natural precious and semiprecious stones	520.11	Free	Free	Free
Diamond, other, advanced in condition or value	520.31	5.2% ad val.	4.9% ad val.	30% ad val.
Diamond, cut, unset, less than 1/2 carat	520.32	Free	Free	10% ad val.
Diamond, cut, unset, over 1/2 carat	520.33	Free	Free	10% ad val.
Rubies, sapphires, cut, unset	520.35	Free	Free	10% ad val.
Marcasites, cut, unset	520.37	0.6% ad val.	Free	20% ad val.
Emeralds, cut, unset	520.38	Free	Free	10% ad val.
Other precious/semiprecious stones, jewelry	520.39	2.2% ad val.	2.1% ad val.	30% ad val.
Precious stones, n.s.p.f.	520.51	7.5% ad val.	7.5% ad val.	30% ad val.
Rock crystal, n.s.p.f.	520.54	6.6% ad val.	6% ad val.	50% ad val.
Semiprecious stones	520.61	21% ad val.	21% ad val.	50% ad val.
Synthetic gem stones, cut, unset	520.71	3.2% ad val.	3.1% ad val.	10% ad val.
Other synthetic gem stones	520.75	7.5% ad val.	6% ad val.	30% ad val.
Pearls, natural	741.05	Free	5/Free	10% ad val.
Pearls, cultured	741.06	2.2% ad val.	2.1% ad val.	10% ad val.
Pearls, imitation	741.10	9.5% ad val.	6/8% ad val.	60% ad val.
Coral, cut but unset	741.15	2.2% ad val.	5/2.1% ad val.	10% ad val.
Gem stones, imitation, exc. beads	741.35	2.9% ad val.	7/2.8% ad val.	20% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated.
1/ Excluding industrial corundum, diamond, and garnet, see pages 44-45, 46-47, and 56-57, respectively.
2/ Estimate includes operators of fee site deposits.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ Diamond only.
5/ Fixed rate for LDDCs. 2.1% ad val.
6/ Fixed rate for LDDCs. 8% ad val.
7/ Fixed rate for LDDCs. 2.8% ad val.
8/ Data in thousands of carats of gem diamond.
9/ See page 182 for definitions.

Prepared by J. W. Pressler, telephone number (202) 634-1206.

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8. Events, Trends, and Issues: Imports of rough diamond for cutting, exclusive of industrial applications, were 990,000 carats, valued at $300 million, an 8% decrease in value compared with that of 1984. The Republic of South Africa was the source of 60% of these imports, enabling it to reduce some of its $1.95 billion stock of rough diamond. Imports of cut diamond also showed a 5% decrease. Imports from India of small gem diamond, averaging 18 points and valued at $163 per carat, amounted to 2.5 million carats, approximately 37% of all U.S. imports of cut diamond goods.

Except for a few gem diamond finds each year in Arkansas, U.S. production is nil. A small amount of other natural precious gems is produced in the United States and large quantities of better grade natural and synthetic gems are imported. The domestic commercial gem stone mining industry includes emerald in North Carolina; jade, opal, and sapphire in the Western States; star garnet from Idaho; turquoise in the Southwestern States; tourmaline in Maine and California, and jade from Alaska. From a 1985 base, output is not expected to grow through 1990. It is estimated that in 1986 the value of domestic mine production of gem stones will be $7.5 million, and the value of U.S. apparent consumption will be $2.7 billion. Natural stones commanded higher prices than synthetics for jewelry applications. Heat treatment, and other means, to enhance color and quality of cheaper stones is commonly practiced.

About 100 kimberlite pipes, 14 of them yielding diamonds, were discovered in Wyoming and Colorado since 1960 by private companies and the Wyoming Geological Survey. An airborne remote-sensing project for kimberlite detection was completed in 1983 and under interpretation in 1984-85. Two beneficiation pilot plants have been erected in Fort Collins, CO, for testing of large scale (up to 50-ton) kimberlite samples. A 3000-ton sample was processed through a pilot plant, found to be diamondiferous, and a 500-carat sample of gem and industrial-quality diamonds was being evaluated. Investigations and sampling were continuing. Prospecting and sampling of diatremes in Michigan and Wisconsin occurred.

9. World Mine Production and Reserve Base: 8/

	Mine Production 1984	Mine Production 1985 e/	Reserve Base 9/
United States	-	-	World reserves of gem diamond are substantial. No reserve data are available for other gem stones.
Angola	970	870	
Australia	2,560	2,300	
Botswana	5,810	5,800	
Brazil	220	200	
Central African Republic	270	250	
Ghana	35	40	
Guinea	34	30	
Guyana	5	5	
India	12	12	
Indonesia	5	5	
Liberia	108	100	
Namibia	884	880	
Sierra Leone	240	250	
South Africa, Republic of	4,516	4,500	
Tanzania	182	180	
Venezuela	75	70	
Zaire	5,169	5,000	
U.S.S.R.	4,300	4,300	
China	200	150	
World Total (may be rounded)	25,595	25,000	

10. World Resources: The world gem diamond reserves are estimated to be about 300 million carats, including near-gem and cheap-gem material. Most of the reserves are in southern Africa, the U.S.S.R. (Siberia), and Western Australia. Estimation of a reserve base is now more volatile because of the changing economic evaluation of near-gem and cheap-gem materials.

11. Substitutes: Plastics, glass, metals, wood, paper, and other materials are substituted for gem stones. Synthetic materials of similar compositions substitute for natural gem stones.

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GERMANIUM

(Data in kilograms of germanium content, unless noted)

1. Domestic Production and Use: Based on the 1985 published domestic producer price, the value of domestic refinery production of germanium was about $21 million. Processed residues from certain domestic ores, industry generated scrap, and imported raw materials were the source materials for germanium production in 1985. The domestic industry consisted of four germanium refineries located in New York, Oklahoma, Pennsylvania, and Texas and two mining operations located in Tennessee and Utah. The company located in Clarksville, TN, produced germanium residues from domestic zinc ores for shipment overseas. A domestic firm recovered germanium and gallium from previously mined material left from a closed copper mining operation near St. George, UT. Companies consuming germanium were located primarily in the Northeast, Texas, and California. The major end uses for germanium were infrared optics, 60%; fiber optic systems, 15%; detectors, 10%; and semiconductors (including transistors, diodes, and rectifiers), 5%. Other applications for germanium included catalysts, phosphors, metallurgy, and chemotherapy.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, refinery e/	28,000	26,000	20,000	20,000	20,000
Imports for consumption 1/	10,000	6,000	6,500	6,000	11,000
Exports		Not available			
Consumption e/	38,000	42,000	35,000	35,000	35,000
Price, producer, yearend, dollars per kilogram: Zone refined, first reduction quality	1,060	1,060	1,060	1,060	1,060
Dioxide	660	660	660	660	660
Stocks, producer, yearend		Not available			
Employment, plant e/ 2/	80	80	80	85	90
Net import reliance 3/ as a percent of apparent consumption		Not available			

3. Recycling: More than 50% of the metal used during the manufacture of most electronic and optical devices is routinely recycled as new scrap. As a result of dispersal in microelectronic devices, very little germanium is returned as old scrap. High purity optical devices may ultimately constitute a large source of recyclable material.

4. Import Sources (1981-84): Belgium-Luxembourg 51%, United Kingdom 12%, France 10%, Federal Republic of Germany 9%, Other 18%.

5. Tariff:

	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Germanium dioxide	423.00	3.9% ad val.	3.7% ad val.	25.0% ad val.
Metal, unwrought, waste and scrap	628.25	3.9% ad val.	3.7% ad val.	25.0% ad val.
Metal, wrought	628.30	5.9% ad val.	5.5% ad val.	45.0% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile:

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Germanium	30,000	-	-	-

e/ Estimated. NA Not available.
1/ Estimated germanium content based on comparison of value per kilogram of imported germanium material with published producer price for germanium metal. Does not include imports of germanium dioxide and other germanium compounds, data for which are not available.
2/ Employment related to primary germanium refining is indirectly related to zinc refining.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ See page 182 for definitions.
5/ Excluding Zaire.

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8. Events, Trends, and Issues: The largest end use for germanium continued to be in lenses and windows used in the production of infrared sensing and identification systems. Germanium also continued to be used in fiber optic systems. It is estimated that in 1986, domestic refinery production of germanium will be 25,000 kilograms and estimated U.S. consumption will be 40,000 kilograms. From a 1983 base, demand for germanium is expected to increase at an average annual rate of about 6.7% through 1990.

Recovery of crude germanium dioxide from previously mined material from a closed copper mining operation began in late 1985 at a facility in Utah. Development continued on the ore zone which reportedly contains recoverable quantities of copper, silver, and zinc, as well as germanium and gallium. This is the only operation in the world that recovers germanium or gallium as principal products. When fully operational, the plant's annual production capacity is expected to be 17,900 kilograms of contained germanium and 10,000 kilograms of gallium.

The U.S. producer prices for germanium metal and dioxide remained at the levels established in late 1981 ($1,060 and $660 per kilogram, respectively) through October 1985. However, increased supplies of imported materials caused some discounting from these prices during the year.

Germanium has little or no effect upon the environment because it usually occurs only as a trace element in some ores and carbonaceous materials and only small quantities are employed in commercial usage.

9. World Production and Reserve Base:

	Refinery Production e/		Reserve Base 4/
	1984	1985	
United States	20,000	20,000	500,000
Zaire	NA	NA	NA
Other Market Economy Countries	38,000	43,000	NA
Centrally Planned Economies	17,000	17,000	NA
World Total	5/75,000	5/80,000	NA

10. World Resources: The readily available resources of germanium are in some zinc and lead-zinc-copper sulfide ores. If germanium were to be recovered from ash and flue dusts resulting from burning certain coals for power generation, potential worldwide germanium resources would become several billion kilograms.

11. Substitutes: Less expensive silicon has increasingly been substituted for germanium in certain electronic applications. Certain bimetallic compounds of tellurium, selenium, indium, and gallium may also be used; however, germanium is more reliable in some high-frequency and high-power applications and more economical as a substrate for some light emitting diode applications. In infrared guidance systems, zinc selenide or germanium glass can substitute for germanium metal but at the expense of performance.

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GOLD

(Data in million troy ounces of gold content, unless noted)

1. Domestic Production and Use: The domestic mining industry consisted of about 180 lode mines, nearly all in Western States; several dozen large placer mines, nearly all in Alaska; and hundreds of small lode and placer mines. Seven percent of domestic gold was recovered as a byproduct of processing base metals, chiefly copper. In 1985, 25 mines yielded 87% of the gold produced, and 8 of these accounted for about 57%. The value of 1985 mine production was about $760 million. Commercial-grade refined gold came from 28 producers; the number of fabricators was about 3,000. Nearly all jewelry manufacturing was centered in the New York, NY, and Providence, RI, areas. Estimated uses in 1985: jewelry and arts, 52%; industrial (mainly electronic), 35%; dental, 12%; small bars, etc., mainly for investment, about 1%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Mine	1.38	1.47	1.96	2.06	2.40
Refinery: Primary	0.80	0.72	0.89	0.75	0.60
Secondary (incl. toll)	3.08	3.04	'2.98	3.03	2.70
Imports 1/ 2/ 3/	4.65	4.92	4.59	7.87	8.50
Exports 2/	6.44	2.97	3/3.14	4.98	3.80
Consumption: Reported	3.28	3.42	3.06	3.08	3.00
Apparent	3.50	4.10	4.10	4.30	4.30
Price, average selling, dollars per ounce	459.64	375.91	424.00	360.66	318.00
Stocks, yearend: Treasury 4/	264.12	264.05	263.41	262.81	262.70
Industry	0.64	0.78	0.63	0.77	0.60
Assigned to futures trading	2.45	2.30	2.53	2.36	2.10
Employment, mine and mill e/	7,500	6,800	5,200	5,000	6,500
Net import reliance 5/ as a percent of apparent consumption	15	32	19	22	31

3. Recycling: Of an estimated 2.7 million ounces of gold reclaimed from scrap in 1985, about 1.2 million ounces was from old scrap. The balance was from prompt industrial scrap, partly toll-refined. Old scrap supplied about 40% of the gold consumed.

4. Import Sources (1981-84): Canada 56%, Uruguay 9%, Switzerland 6% Other 29%. 2/

5. Tariff: No duties were imposed on imports of unrefined gold or refined bullion. There were duties on items such as platinum-and silver-plated unwrought or semimanufactured gold, but these items constituted a minor portion of U.S. imports.

6. Depletion Allowance: 15% (Domestic), 14% (Foreign).

7. Government Stockpile: No strategic stockpile. However, the U.S. Department of the Treasury maintains stocks of gold (see section 2 above) and a Government-wide precious metals recovery program was begun in early 1984.

e/ Estimated. NA Not available.
1/ Imports for consumption.
2/ Excludes gold contained in fabricated items and official monetary gold movement; also excludes estimates of imported gold coin containing, in million ounces; 2.6 (1981), 2.9 (1982), 1.9 (1983), 2.8 (1984), NA (1985).
3/ Excludes net bullion flow (in million ounces) to market from foreign stocks at the New York Federal Reserve Bank: 1.16 (1981), 1.33 (1982), -0.22 (1983), 0.38 (1984), 0.70 (1985 e/).
4/ Includes gold in Exchange Stabilization Fund. Stocks were valued at the official price of $42.22 per troy ounce.
5/ Defined as imports - exports + adjustments for Government and industry stock changes.
6/ See page 182 for definitions.

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8. Events, Trends and Issues: Domestic gold mine production, in 1985 was the highest since 1950. Exploration and the development of new mines was sustained at a high level with Nevada and California the focal points of activity. More than a dozen new gold mines began production during the year. It is estimated that in 1986 domestic mine production of gold will be 2.6 million ounces and U.S. apparent consumption will be about 3.7 million ounces. From a 1983 base, demand for gold is expected to increase at an average annual rate of about 2.4% through 1990.

On February 24, the price of gold fell to $284 per ounce, its lowest point since August 6, 1979. Subsequent domestic and international economic and political developments combined to drive the price to the year's high of $341 in August and to sustain it thereafter at about $320. The Engelhard Industries/London daily final gold price was about $330 near the end of November. The monthly volume of gold futures contracts traded on U.S. futures exchange markets began the year with over 95 million ounces traded in both January and March. The volume declined erratically thereafter to stand at about 48 million ounces in November.

Environmental pollution abatement continued to be of concern to domestic gold producers, especially in Alaska, where there are many small placer mines.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 6/
	1984	1985 e/	
United States	2.06	2.40	100
Australia	1.20	1.70	30
Canada	2.61	2.70	50
South Africa, Republic of	21.90	22.20	800
Other Market Economy Countries	7.32	7.00	210
China e/	1.90	1.90	260
U.S.S.R. e/	8.65	8.70	
Other Centrally Planned Economies e/	0.40	0.40	
World Total	46.04	47.00	1,450

The world's estimated above-ground gold stocks, excluding gold in industrial usage, total about 2.6 billion ounces, of which 1.14 billion ounces were official stocks of the market economy countries, 0.08 billion ounces were official stocks of centrally planned economy countries, and 1.35 billion ounces were privately held as coin, bullion, or jewelry.

10. World Resources: Total world resources of gold are estimated at 2.4 billion ounces, of which 15% to 20% are byproduct resources. The Republic of South Africa has about one-half of world resources, and the U.S.S.R., Brazil, and the United States about 12% each. Some of the 0.28-billion-ounce U.S. resource would be recovered as byproduct gold.

11. Substitutes: Base metals clad with gold alloys are being used increasingly in electrical/electronic and jewelry products to economize on gold; many of these products are being redesigned to maintain high utility standards with less gold content. Generally, palladium, platinum, and silver may substitute for gold.

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GRAPHITE (NATURAL)

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Natural graphite was not produced domestically in 1985. Apparent consumption of natural graphite, 49,000 tons valued at $14.0 million, was by several hundred manufacturing firms located primarily in the northeastern and Great Lakes regions. The main uses of natural graphite were estimated to be: Refractories, 30%; dressings and molds in foundry operations, 20%; brake linings, 11%; lubricants, 7%; steel production, 6%; crucibles, 6%; and other, 20%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, mine	-	W	W	W	-
Imports for consumption	66	53	44	58	56
Exports	11	10	9	7	7
Consumption, apparent	55	W	W	W	49
Price, imports (average dollars per ton at foreign ports):					
Flake	641	655	550	509	570
Lump and chip (Sri Lankan)	1,509	1,512	1,158	1,065	740
Amorphous (Mexican)	45	54	56	40	50
Stocks, yearend	Not available				
Employment, mine, mill, and processing plant	-	W	W	W	-
Net import reliance 1/ as a percent of apparent consumption	100	W	W	W	100

3. Recycling: None.

4. Import Sources (1981-84): Mexico 55%, China 19%, Brazil 8%, Madagascar 6%, Other 12%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Crystalline flake (not including flake dust):				
Valued not over 5.5¢/lb	517.21	3.6% ad val.	3% ad val.	1.65¢/lb
Valued over 5.5¢/lb	517.24	0.3¢/lb	0.3¢/lb	1.65¢/lb
Lump and chip	517.27	Free	Free	30% ad val.
Other	517.31	Free	Free	10% ad val.

6. Depletion Allowance: 22% (Domestic lump and amorphous), 14% (Domestic flake), 14% (Foreign).

7. Government Stockpile: In addition to data shown below, the stockpile contained 932 tons of nonstockpile-grade material.

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Sri Lanka, amorphous lump	6	5	-	-
Madagascar, crystalline flake	20	18	-	-
Other than Sri Lanka and Madagascar crystalline	3	2	-	-

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ See page 182 for definitions.
3/ Excluding U.S. production.

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8. Events, Trends, and Issues: Availability of graphite was adequate during 1985. Demand was met largely by imports of flake from Brazil, Madagascar, and China, lump and chip from Sri Lanka, and amorphous graphite from Mexico and China. Amorphous graphite accounted for 55% by quantity and 9% by value of total imports in 1985, crystalline flake accounted for 11% by quantity and 20% by value, and lump and chip accounted for 3% by quantity and 8% by value. Imports of all kinds of graphite were down 3% from those of 1984; imports of crystalline flake were down 45%; and imports of amorphous materials from Mexico decreased about 8%. Exports were unchanged, remaining relatively small.

   From a 1983 base, demand for natural graphite is expected to increase at an average annual rate of about 2% through 1990. It is estimated that in 1986 some natural graphite will be produced in the United States and U.S. apparent consumption of graphite will be 47,000 tons.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 2/
	1984	1985 e/	
United States	W	-	1,000
Austria	44	40	Large
India	44	40	Moderate
Korea, Republic of	33	35	Large
Madagascar	14	15	Large
Mexico	46	45	Large
Sri Lanka	7	10	Moderate to Large
Other Market Economy Countries	54	55	Moderate
Centrally Planned Economies	390	390	Large
World Total (may be rounded)	3/632	630	e/166,000

10. World Resources: Domestic resources exceed 10 million tons, and the rest of the world's resources exceed 1.5 billion tons of recoverable graphite. Deposits in Alabama, Alaska, Idaho, New York, and Pennsylvania were not economically viable.

11. Substitutes: Substitute materials are more costly and/or do not perform as well as natural graphite for most applications. Manufactured graphite powder, scrap from discarded machined shapes, and calcined petroleum coke compete for use in iron and steel production. Finely ground coke with olivine is a potential competitor in foundry facing operations. Molybdenum disulfide competes as a dry lubricant but is more sensitive to oxidative conditions.

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GYPSUM

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: In 1985, output of crude gypsum was 14.4 million tons valued at $120 million, an increase of 1% in tonnage compared with that of 1984. Leading States were Texas, Oklahoma, Michigan, Iowa, California, and Nevada, which together accounted for 65% of the total. Forty-two companies mined crude gypsum at 69 mines in 22 States, and 14 companies calcined gypsum at 71 plants in 30 States. Of the total supply of crude gypsum, 24.5 million tons, including 800,000 tons of byproduct gypsum, 19.1 million tons was calcined for gypsum products, and 5.4 million tons was used mainly as a cement retarder or as agricultural land plaster. The calcined gypsum was sold as prefabricated products or as industrial or building plaster. Sales of gypsum for use in cement were 4.1 million tons; for agriculture, 1.3 million tons; and for industrial and building plaster, 770,000 tons.

   Available capacity of operating gypsumboard plants in the United States at yearend 1985 was 21.5 billion square feet per year. Sales of gypsumboard products were 19.1 billion square feet, which represented a capacity utilization of 89%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Crude	11,497	10,538	12,884	14,319	14,400
Byproduct	696	697	760	780	800
Calcined	11,687	11,243	13,902	15,450	16,700
Prefabricated products (million square feet)	13,754	13,086	16,763	18,314	19,100
Imports, crude, including anhydrite	7,593	6,718	8,031	8,904	9,300
Exports, crude, not ground or calcined	7	8	6	6	6
Consumption, crude, apparent 1/	19,438	17,498	22,710	24,221	24,520
Price: Average crude, f.o.b. mine, dollars per ton	8.53	8.46	7.87	7.94	8.30
Average calcine, f.o.b. plant, dollars per ton	20.80	17.48	19.43	20.75	21.00
Stocks, producer, crude, yearend	3,544	3,991	2,950	2,726	2,700
Employment, mine and calcining plant	6,300	5,900	6,500	6,600	6,700
Net import reliance 2/ as a percent of apparent consumption	37	36	40	38	38

3. Recycling: Byproduct gypsum generated in flue gas desulfurization, phosphate rock acidulation, and other chemical processes is not reclaimed, except for a small amount sold for agricultural and wallboard purposes.

4. Import Sources (1981-84): Canada 71%, Mexico 20%, Spain 8%, Other 1%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Crude, not ground or calcined	512.21	Free	Free	Free
Ground, wholly or partly calcined 3/	512.24	44¢	42¢	$1.40
Plaster of paris articles, n.s.p.f.	512.44	5% ad val.	Free	60% ad val.
Alabaster articles, n.s.p.f.	513.94	6.5% ad val.	Free	50% ad val.
Gypsum or plaster building board	245.70	2.9% ad val.	2.4% ad val.	30% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile:

e/ Estimated.
1/ Defined as crude + byproduct + imports - exports + industry stock adjustment.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ Per long ton.
4/ See page 182 for definitions.

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8. Events, Trends, and Issues: The gypsum industry in 1985 followed the high activity of the construction and housing industry, with 1.7 million housing starts, virtually the same as that of 1984. Production of domestic crude gypsum increased 6%, imports increased 4%, and sales of prefabricated products increased 4%.

In 1985, the gypsum wallboard industry continued the high rate of shipments established in 1984, and attained new monthly records for the last 9 months of 1985. Total wallboard shipments for 1985 were 19.1 billion square feet, up 4% from those of 1984 and a new annual record. Most plants were on allocation to their best customers, and operated 164 of a weekly maximum of 168 hours. Some spot shortages developed in retail outlets and contractor requirements. Shipments of imported wallboard from Norway, the Netherlands, and Spain increased. The average price of wallboard in 20 principal cities increased about 3% from beginning to yearend. Imports of wallboard principally from Canada were 780 million square feet, 2% less than those of 1984. Wallboard exports to 13 different countries were 40 million square feet. Improvements in line operations, including some replacements occurred; this, combined with one expansion project resulted in a yearend gypsumboard capacity of 21.5 billion square feet per year.

As long as the cost of land for solid waste disposal continues to be economical and solid waste pollution remains noncritical, only a small amount of the potentially useful byproduct gypsum scrubbed from powerplant stack gases and produced by chemical plants will be used. For the first time in the United States, a gypsum wallboard plant is under construction in northeast Texas based solely on a synthetic gypsum feed.

From a 1983 base, demand for gypsum is expected to increase at an average annual rate of about 1.9% through 1990. It is estimated that in 1986 domestic mine production of gypsum will be 14.4 million tons and U.S. apparent consumption will be 24.5 million tons.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 4/
	1984	1985 e/	
United States	14,319	14,400	500,000
Australia	2,200	2,300	800,000
Canada	9,600	9,800	
France	6,000	6,100	
Germany, Federal Republic of	2,400	2,500	
Iran	5,500	5,300	
Italy	1,400	1,500	Reserves are large
Japan	6,700	6,800	in major producing
Mexico	3,300	3,500	countries but data
Spain	6,200	6,600	are not available.
United Kingdom	3,300	3,200	
Other Market Economy Countries	13,294	13,300	
China	5,300	5,500	
Poland	1,430	1,350	
Romania	2,000	2,100	
U.S.S.R.	5,400	5,400	
Other Centrally Planned Economies	1,959	2,000	
World Total	90,302	91,650	Large.

10. World Resources: Domestic resources are adequate but are unevenly distributed. There are no gypsum deposits on the eastern seaboard of the United States, and large imports from Canada augment the domestic supply of crude ore in these industrial areas. Large deposits occur in the Great Lake region, mid-continent region, California, and other States. Foreign resources are adequate but are not evenly distributed.

11. Substitutes: Other construction materials may be substituted for gypsum, especially lime, lumber, cement, steel, or masonry. There is no practical substitute for gypsum in portland cement. Byproduct gypsum is presently substituting for crude gypsum in special agricultural applications, and may, in time, be utilized in place of crude gypsum for cement set-retarding and manufacturing wallboard.

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HAFNIUM 1/

(Data in short tons of hafnium content, unless noted)

1. Domestic Production and Use: Hafnium is recovered as a byproduct in the production of hafnium-free, nuclear-grade, zirconium-base alloys. Two companies, one with a plant in Oregon and another with a plant in Utah, produced primary hafnium sponge and hafnium crystal bar. About 50% of the hafnium produced was used in naval nuclear reactors for control rods. Other uses were in ceramics, refractory applications, alloys, and as carbide in cutting tool alloys.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Sponge	W	W	W	W	W
Crystal bar e/	50	50	50	50	50
Imports for consumption	Negligible				
Exports	None				
Consumption, apparent: Sponge	W	W	W	W	W
Crystal bar e/	45	45	50	55	55
Price, sponge, dollars per pound, domestic 2/	70-135	70-125	70-125	80-130	80-130
Stocks, yearend, sponge and crystal bar e/	35	35	35	30	30
Employment, metal plant	3/	3/	3/	3/	3/
Net import reliance 4/ as a percent of apparent consumption	W	W	W	W	W

3. Recycling: Insignificant.

4. Import Sources (1981-84): France 100%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	(Non-MFN) 1/1/86
Unwrought hafnium, waste and scrap	628.35	0.6% ad val.	Free	25.0% ad val.
Wrought hafnium	628.40	9.0% ad val.	9.0% ad val.	45.0% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
1/ See also Zirconium.
2/ Price varies with quantities purchased.
3/ Small portion of primary zirconium metal plant employment.
4/ Defined as imports - exports + adjustments for Government and industry stock changes.
5/ See page 182 for definitions.

Prepared by W. Timothy Adams, telephone number (202) 634-1082.

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8. Events, Trends, and Issues: Increased use of hafnium as an alloying agent in high temperature refractory alloys, and for hafnium-columbium carbide in cutting tool alloys continued in 1985. It is estimated that in 1986 domestic production and apparent consumption of hafnium crystal bar will each be about 50 tons. From a 1983 base, demand for hafnium is expected to increase at an average annual rate of about 4.7% through 1990. Hafnium is available at reasonable cost as long as there is a continuing demand for reactor-grade zirconium.

9. World Mine Production and Reserve Base: Hafnium occurs in the mineral zircon, which usually contains about 2% hafnium. World primary hafnium production statistics are not available. The U.S. reserve base 5/ of hafnium associated with zircon amounts to about 80,000 tons.

10. World Resources: Resources of hafnium in the United States are estimated to be 140,000 tons, available in the 14-million-ton domestic resources of zircon. World resources of hafnium are associated with those of zircon, and exceed 500,000 tons.

11. Substitutes: There are no substitutes for hafnium in its major applications, nuclear reactor control rods and refractory metal alloys, but zirconium oxide and metal can be substituted in selected refractories and ceramics.

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HELIUM

(Data in million cubic feet of contained helium gas measured at 14.7 psia and 70° F, unless noted)

1. Domestic Production and Use: During 1985, the estimated value of Grade-A (99.995% or better) helium extracted at the Bureau of Mines Exell Helium Plant was $15 million, and the estimated value of Grade-A helium extracted by private industry was $50 million. The total sales value for domestic consumption and exports was $65 million. Seven private industry plants and one Bureau of Mines facility extracted helium from natural gas; four of the privately owned plants were in Kansas, one in New Mexico, and two in Texas. Private industry is building a new helium extraction plant in Kansas, which was scheduled for initial operation in November, but is not yet on-line. The Grade-A helium produced was consumed principally in Western and Gulf Coast States. The estimated domestic consumption of 1,300 million cubic feet used in 1985 was predominantly 33% for cryogenic applications, 19% for welding cover gas, 18% for pressurizing and purging, and 8% for synthetic breathing mixtures for deep sea diving.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Helium extracted from natural gas 1/	1,065	232	575	1,174	1,250
Grade-A helium sales	1,255	1,245	1,363	1,637	1,750
Imports for consumption			None		
Exports 2/	389	378	368	392	450
Consumption, apparent 2/	866	867	995	1,245	1,300
Employment, plant e/	600	550	550	550	580
Net import reliance 3/ as a percent of apparent consumption			Net exporter		

Price: The Bureau's price of Grade-A gaseous helium, f.o.b. Bureau plants, was $37.50 per thousand cubic feet during 1985. Private producers of helium maintained their selling price of Grade-A helium gas at about $37 per thousand cubic feet, and the price of liquid helium at about $55 per thousand cubic feet, including surcharges.

3. Recycling: In the United States, helium used in large-volume applications is seldom recycled. Some low-volume or liquid boiloff recovery systems are used. In Western Europe and Japan, helium recycling is practiced when economically feasible.

4. Import Sources (1981-84): None.

5. Tariff:

	Number	Most Favored Nation (MFN)		NON-MFN
		1/1/86	1/1/87	1/1/86
Helium	415.50	3.9% ad val.	3.7% ad val.	25.0% ad val.

6. Depletion Allowance: Allowances are applicable to natural gas from which helium is extracted, but none is granted directly to helium.

e/ Estimated. NA Not available.
1/ Helium content of both Grade-A and crude helium (consisting of approximately 70% helium and 30% nitrogen).
2/ Grade-A helium.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ See page 182 for definitions.
5/ All domestic measured and indicated helium resources in the United States.
6/ Excludes Other Market Economy Countries.

Prepared by William D. Leachman. For further information call Armond A. Sonnek, Assistant Director--Helium Operations, (202) 634-4734.

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7. Government Stockpile: In addition to the data shown below, the Bureau accepted 450 million cubic feet of private helium for storage and redelivered 950 million cubic feet for a net reduction in storage of 500 million cubic feet. On 9/30/85, 37.4 billion cubic feet of helium was in storage, of which 2.5 billion cubic feet was owned by private firms.

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized for Disposal	Sales, 9 Months
Helium	-	34.9 billion cubic feet	-	-

8. Events, Trends, and Issues: From a 1984 base, demand for helium is expected to increase at an average annual rate of about 5% through 1990. It is estimated that in 1986 domestic production of helium will be 1.9 billion cubic feet and U.S. apparent consumption will be 1.4 billion cubic feet.

9. World Production and Reserve Base:

	Production		Reserve Base 4/ 5/
	1984	1985 e/	
United States	1,637	1,750	495,700
Other Market Economy Countries	NA	NA	NA
Centrally Planned Economies e/	150	150	NA
World Total 6/	1,787	1,900	NA

10. World Resources: For the United States, it is postulated that by the end of the century, the few large helium-rich natural gasfields that are currently supplying helium will be exhausted. Future supplies will come from known leaner sources, new helium-bearing natural gas wells, or from known helium-rich natural gas with little fuel value. The Riley Ridge field, one of these helium-rich gas fields with low-fuel value, is presently being developed. The development of this field will result in its removal from the shut-in classification. Riley Ridge helium reserves are estimated to be about 100 billion cubic feet. As of December 31, 1985, approximately 43 billion cubic feet of helium was estimated to be in domestic natural gas reserves with a helium content of less than 0.3%. Shut-in and/or low-heating-value gasfields having measured and indicated helium resources with a minimum helium content of 0.3% were estimated to contain 142 billion cubic feet of helium.

Helium resources in the world exclusive of those in the United States and the centrally planned economies were estimated to be 194 billion cubic feet. The locations and volumes of the principal deposits in billion cubic feet are Algeria, 77; Canada, 65; and the Netherlands, 25. As of December 31, 1985, the Bureau of Mines had analyzed 17,901 gas samples from 37 countries and the United States in a program to identify world helium resources.

11. Substitutes: There is no substance that can be substituted for helium if temperatures below -429° F are required. Argon can be substituted for helium in welding, and hydrogen can be substituted for helium in some lighter-than-air applications where the flammability of hydrogen is not objectionable. Hydrogen is also being investigated as a substitute for helium for deep sea diving applications below 1,000 feet.

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ILMENITE 1/

(Data in thousand short tons of concentrate, unless noted)

1. Domestic Production and Use: Two firms produced ilmenite concentrate from three operations in Florida. Based on prices the value of reported U.S. ilmenite and titanium slag consumption in 1985 totaled $85 million. Major coproducts of ilmenite from sand deposits are zircon and rutile and at one hardrock deposit where ilmenite production was suspended in 1984, magnetite. Ilmenite and titanium slag were consumed by 13 companies. Four titanium pigment producers used 99% of the ilmenite and titanium slag consumed. The rest was used in welding-rod coatings and for manufacturing metal, alloys, carbide, and chemicals.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production	542	263	W	W	W
Imports for consumption 2/	505	596	398	619	750
Exports	NA	19	1	4	-
Consumption: Reported 2/	1,109	809	897	984	1,020
Apparent 2/	1,092	1,020	W	W	W
Price, dollars per long ton:					
Ilmenite:					
54% TiO_2, f.o.b. Atlantic ports	70	70	70	70	NA
Domestic, f.o.b. Titen, FL	39	44	44	44	44
Slag:					
70%-80% TiO_2, f.o.b. Sorel, Quebec 3/	135	150	162	185	196
85% TiO_2, f.o.b. Richards Bay, Republic of South Africa	e/175	e/175	e/180	200	212
Stocks, mine, distributor and consumer, yearend 2/	1,058	878	477	281	310
Employment, mine and mill 4/	600	450	370	380	400
Net import reliance 5/ as a percent of apparent consumption	50	74	W	W	W

3. Recycling: Insignificant.

4. Import Sources (1981-84): 2/ Australia 59%, Canada 35%, Republic of South Africa 6%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Titanium ore (including ilmenite and ilmenite sand)	601.5120	Free	Free	Free
Titanium slag	603.6200	Free	Free	Free

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
1/ See also Rutile and Titanium.
2/ Includes titanium slag from Canada and the Republic of South Africa, and 7,000 to 15,000 tons per year leucoxene.
3/ Contained 70% to 72% TiO_2 in 1981-82, 74% TiO_2 in late 1982 to October 1983, then 80% TiO_2.
4/ Includes operating employees shown under Rutile, subject to the same footnoted comments.
5/ Defined as imports - exports + adjustments for Government and industry stock changes.
6/ See page 182 for definitions.
7/ Excluding U.S. production.

Prepared by L. E. Lynd, telephone number (202) 634-1073.

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8. Events, Trends, and Issues: In 1985 domestic mine production of ilmenite increased about 17%. Imports were 21% higher than those of 1984.

It is estimated that in 1986 U.S. consumption of ilmenite will be a little over 1 million tons. From a 1984 average base, demand for ilmenite is expected to increase at an average annual rate of about 1.5% through 1990.

Environmental problems related to ilmenite include: (1) Land-use conflicts where black-sand deposits exist, principally along the Atlantic coast, and (2) the potential for water pollution from pigment-producing processes that use ilmenite - up to 3.5 tons of waste per ton of product using the sulfate process, and 1.2 tons of waste per ton of product from the chloride process. Solutions to the latter problem include the development of economic and environmentally acceptable processes for making synthetic rutile or titanium tetrachloride from lower grade ilmenites, and the development of methods to neutralize and control the effluents now produced. The two U.S. producers using the sulfate process treated their spent acid effluent with calcium carbonate and lime, producing a gypsum byproduct, part of which was sold to wallboard and cement manufacturers and for agricultural use. One company upgrades part of its waste ferric chloride effluent for use in water treatment, and uses deep-well disposal of ferric chloride at most of its pigment plants.

Synthetic rutile was produced at one domestic plant, at Mobile, AL, using Australian ilmenite as feed material.

Plans were announced to expand heavy mineral mining and ilmenite smelting operations at Richards Bay, Republic of South Africa. Smelter capacity was to be increased by 50% to about 660,000 tons per year of 85%-TiO_2 slag. Cost of the 2-year project was expected to be about $68 million. A smelting plant was under construction in Tyssedal, Norway, to produce about 220,000 tons per year of 75%-TiO_2 slag product from ilmenite being mined in Rogaland County, Norway, to be completed in 1986. The Otanmaki ilmenite mine in Finland was to close by yearend because of depleted reserves.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 6/
	1984	1985 e/	
United States	W	W	68,000
Australia	1,210	1,340	87,000
Brazil	55	55	3,000
Canada (slag production)	800	820	160,000
Finland	184	140	6,000
India	165	170	63,000
Malaysia	215	200	2,000
Norway	606	700	120,000
South Africa, Republic of (slag production)	460	460	100,000
Sri Lanka	88	90	8,000
China	154	155	90,000
U.S.S.R.	485	485	27,000
World Total	7/4,422	7/4,615	734,000

10. World Resources: Ilmenite supplies about 90% of the world's demand for titaniferous material. World ilmenite resources total about 1 billion tons of titanium dioxide. Major resources occur in Australia, Canada, India, Norway, the Republic of South Africa, the United States, the U.S.S.R., and China.

11. Substitutes: Rutile and synthetic rutile were also extensively used to produce titanium dioxide pigment.

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INDIUM

(Data in thousand troy ounces of metal, unless noted)

1. Domestic Production and Use: Domestic indium production was derived from residues generated in the refining of zinc and other base metal concentrates. Three companies in New York, Pennsylvania, and Rhode Island refined indium from these materials during 1985. Several firms located in Eastern States produced high purity shapes, alloys and compounds from indium ingots. Estimated uses for the metal in 1985 were: Electrical and electronic components, 40%; solders, alloys, and coatings, 40%; and research and other, 20%. The estimated value of consumption in 1985, based on the average price, was $1.6 million.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, refinery		Not available			
General imports, metal	461	686	1,071	1,022	1,100
Exports		Not available			
Consumption e/	500	500	500	600	600
Price, average annual, dollars per troy ounce	7.53	4.18	3.19	3.00	2.63
Stocks, producer, yearend		Not available			
Employment		Not available			
Net import reliance 1/ as a percent of apparent consumption		Not available			

3. Recycling: Insignificant.

4. Import Sources (1981-84): Belgium-Luxembourg 22%, France 20%, Italy 16%, United Kingdom 15%, Other 27%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Unwrought and waste and scrap	628.45	0.2% ad val.	Free	25.0% ad val.
Wrought	628.50	4.3% ad val.	3.6% ad val.	45.0% ad val.
Compounds	423.96	0.6% ad val.	Free	25.0% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. NA Not available.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ Estimate based on indium content of zinc ores. See page 182 for definitions.
3/ Excluding production from Other Market Economy Countries and the United States.

Prepared by J. F. Carlin, Jr., telephone number (202) 634-1073.

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8. Events, Trends, and Issues: In recent years, domestic indium production was estimated to have fluctuated within a relatively narrow band. In 1985, domestic production and demand remained about the same as the previous year and imports increased. It is estimated that in 1986 U.S. consumption of indium will be 600,000 troy ounces. From a 1983 base, domestic demand for indium is expected to increase at an average annual rate of about 1.5% through 1990.

In 1985, the domestic producer price of indium declined from $3.10 to $2.50 per troy ounce toward yearend. No toxic effects of indium have been reported and no special treatment has been required to remove it from waste products at smelters.

Established uses for indium included plating on electronic components, low melting alloys, solders, coating on electrical contacts, dental alloys, nuclear reactor control rods, and infrared detectors. A growing use was as a transparent, electrically conductive coating on glass, such as used for liquid-crystal displays on wristwatches and calculators. Research continued on the use of indium in solar cells and on indium-tin oxide coatings for plastic films.

9. World Production and Reserve Base:

	Refinery Production e/		Reserve Base 2/
	1984	1985	
United States	NA	NA	17,000
Canada	100	100	18,000
Japan	400	400	4,000
Peru	100	200	4,000
Other Market Economy Countries	NA	NA	37,000
U.S.S.R.	200	200	8,000
Other Centrally Planned Economies	150	150	8,000
World Total	3/950	3/1,050	96,000

10. World Resources: Identified resources of indium occur primarily in zinc sulfide ores in many parts of the world. However, the indium content is not the same in all zinc ores.

11. Substitutes: Alternate materials are available for most uses of indium. In transistors, silicon has generally replaced germanium-indium. For some alloys, if cost is not an important factor, gallium can be used as a substitute. Boron carbide and hafnium can replace indium in nuclear reactor control rods.

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IODINE

(Data in thousand pounds, unless noted)

1. Domestic Production and Use: The large operation at Woodward, OK, and the long-established producer of byproduct iodine at Midland, MI, continued production of iodine from subterranean brines. A third company continued a pilot-size facility in Kingfisher County, OK, using brine associated with oil production. Twenty-nine plants reported consumption of crude elemental iodine. Prices began to rise but consumption of iodine remained stable.

   Demand for iodine was in the following downstream distribution categories: Catalysts, animal feed additives, pharmaceuticals, sanitary and industrial disinfectants, stabilizers, inks and colorants, photographic equipment, and other.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production	W	W	W	W	W
Imports for consumption, crude	6,100	4,700	6,200	5,100	5,000
Exports		Not Available			
Shipments from Govt. stockpile excesses	37	445	50	109	-
Consumption, apparent	8,800	6,900	8,100	W	W
Price, average CIF value, dollars per pound, crude	6.03	5.97	5.57	4.90	5.35
Stocks, producer, yearend	W	W	W	W	W
Employment, processing plant	1/470	1/470	1/430	50	50
Net import reliance 2/ as a percent of apparent consumption	W	W	W	W	W

3. Recycling: Iodine was recycled, but no data are available.

4. Import Sources (1981-84): Japan 78%, Chile 21%, Other 1%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Iodine, crude	415.25	Free	Free	Free
Iodine, resublimed	415.27	6.2¢/lb	6.0¢/lb	10.0¢/lb
Potassium iodide	420.20	2.9% ad val.	2.8% ad val.	7.5% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: In addition to the quantity shown below, the stockpile contains 4,474 pounds of nonstockpile-grade material available for disposal.

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Stockpile grade	5,800	7,368	-	-

e/ Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
1/ Including bromine.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 182 for definitions.
4/ Excluding U.S. production.

Prepared by P. A. Lyday, telephone number (202) 634-1177.

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8. Events, Trends, and Issues: The producer in Michigan announced the closure of the network of brine wells that supply brine to the iodine facility by the end of 1986. The brine system included 72 production wells, 36 reinjection wells, 17 solution mining wells, and about 150 miles of pipeline. The closure is a result of brine spillage polluting drinking water.

The major world producer, Japan, produced iodine from gas brines. Japan continued exploration to find new sources of iodine-rich brines.

The second largest producer of iodine, Chile, produced iodine as a coproduct of sodium nitrate. The production of iodine increased as a result of selectively mining areas with high iodine concentrations.

At the Nebit-Dag iodine-bromine plant in Turkmenistan, the U.S.S.R., an experimental facility to extract boron, calcium, magnesium, and sodium from the brines was planned. At the Neftechala iodine-bromine plant in Azerbaidzhan, construction was completed on the first stage of renovation.

The release of radioactive iodine from the Three Mile Island nuclear powerplant in 1979 caused concern over human exposure to radioactivity. The ingestion of potassium iodide (KI) to reduce the uptake of radioiodides by the thyroid was investigated. On June 20, 1985, the Federal Emergency Management Agency published in the Federal Register its decision not to require the predistribution or stockpiling of KI for use by the general public. Decision-making on distribution and use of KI was left to State and local authorities.

The U.S. Food and Drug Administration continued provisional status for Red No. 3 dye, or erythrosine. Red No. 3 dye has a grapelike color and contains 58% iodine, by weight. Erythrosine had been used in carbonated soft drinks, powdered drinks, gelatin desserts, icings, and pet foods. Erythrosine is one of three dyes that account for over one-half of the total domestic annual food dye consumed. Amendments to the Food, Drug, and Cosmetic Act of 1960, the Delaney clause, require that all permanently listed dyes be proven safe. Grounds to ban Red No. 3 have not been substantiated at even the highest levels of human exposure.

From a 1983 base, demand for iodine is expected to increase at an average annual rate of about 1.1% through 1990.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 3/
	1984	1985 e/	
United States	W	W	550,000
Chile	5,700	5,900	1,200,000
Indonesia	57	60	100,000
Japan	16,098	16,000	7,000,000
Other Market Economy Countries	-	-	NA
China	1,000	1,000	400,000
U.S.S.R.	4,400	4,400	400,000
Other Centrally Planned Economies	-	-	NA
World Total (may be rounded)	4/27,300	4/27,400	9,650,000

10. World Resources: In addition to the fields listed in the reserve base, seawater contains 0.05 parts per million iodine, or approximately 76 billion pounds. Seaweeds of the Laminaria family are able to extract and accumulate up to 0.45% iodine on a dry basis. While not as economical as the production of iodine as a byproduct of gas, oil, and nitrate, the seaweed industry represented a major source of iodine prior to 1959 and a large resource.

11. Substitutes: Bromine and chlorine could be substituted for most of the biocide, ink, and colorant uses of iodine, although they are usually considered less desirable. Antibiotics and mercurochrome also substitute for iodine as biocides. Salt crystals and finely divided carbon may be used for cloud seeding. There are no substitutes in catalytic, nutritional, pharmaceutical, animal feed, and photographic uses.

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IRON ORE 1/

(Data in million long tons of ore, 2/ unless noted)

1. Domestic Production and Use: Mine value of usable iron ore produced from domestic mines in 1985 was estimated at $2.1 billion. Iron ore was produced by 18 companies operating 22 mines, 20 concentration plants, and 11 pelletizing plants. The mines included 21 open pits and 1 underground mine. Virtually all ore was concentrated before shipment, and about 97% was pelletized. Average iron content of usable ore was about 64%. Twelve mines operated by nine companies accounted for 99% of the output. Domestic steel companies directly controlled about 79% of production. Minnesota produced about 72% of the output, Michigan 26%, and the rest was produced in seven other States. Consumption of iron ore and agglomerates was distributed approximately as follows: Blast furnaces, 98%; steel furnaces, 0.5%; and manufacture of cement, heavy media materials and other products, 1.5%. Approximate consumption by region was: Illinois-Indiana-Michigan, 46%; Ohio-Pennsylvania, 32%; Maryland-West Virginia, 9%; most of the remainder was consumed in four other States.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production	73.2	35.4	37.6	51.3	48.0
Imports for consumption	28.3	14.5	13.2	17.2	16.0
Exports	5.5	3.2	3.8	5.0	4.8
Consumption: Reported (ore and agglomerates)	104.4	63.9	70.6	72.5	70.4
Apparent	94.0	54.4	60.0	64.1	61.7
Price (November), Lake Superior ores, delivered rail of vessel at lower lake ports:					
Natural ores, basis 51.5% Fe, dollars per long ton	32.25-32.78	32.25-32.78	30.03-32.78	30.03-32.78	30.03-32.78
Pellets, cents per long ton unit of Fe	80.5	80.5-86.9	80.5-86.9	80.5-86.9	58.0-86.9
Stocks, mine, dock, and consuming plant, yearend, excl. byproduct ore 3/	55.5	47.8	32.8	32.2	29.7
Employment, mine, concentrating and pelletizing plant, quarterly average	18,200	9,200	7,600	8,200	7,800
Net import reliance 4/ as a percent of apparent consumption (iron in ore)	22	34	37	19	22

3. Recycling: Insignificant.

4. Import Sources (1981-84): Canada 66%, Venezuela 13%, Liberia 11%, Brazil 9%, Other 1%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Iron ore	601.24	Free	Free	Free

6. Depletion Allowance: 12.75% (Domestic) and 11.9% (Foreign).

7. Government Stockpile: None.

e/ Estimated.
1/ See also Iron and Steel, and Iron and Steel Scrap.
2/ Usable ore, including byproduct ore.
3/ Data for 1981 and 1982 are not comparable to data shown for subsequent years, owing to reclassification of some mine stocks. Adjustments of data for 1981 and 1982 are withheld to avoid disclosing company proprietary data.
4/ Defined as imports - exports + adjustments for Government and industry stock changes.
5/ See page 182 for definitions.

Prepared by F. L. Klinger, telephone number (202) 634-1023.

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8. Events, Trends, and Issues: World iron ore production, trade, and consumption increased slightly in 1985 from the levels of 1984. Relatively strong demand in Western Europe and Japan during the first 9 months offset a decline in North American demand. Most prices for lump ore and fines increased by about 1.5% to 3%, while prices for pellets were unchanged or declined by about 3% from 1984 levels. Ocean freight rates for spot charterings appeared to be the lowest in 7 years.

In the United States, production was about 6% less than in 1984, as demand for domestic ore remained weak owing to imports of iron, steel, and ore; closure of blast furnaces at some inland locations; and relatively high costs of production and transport. Of the country's 12 pelletizing plants, 1 was closed permanently, 1 remained idle, and 7 were temporarily closed for periods ranging from 5 to 15 weeks. Published prices for Lake Superior pellets were reduced by 12% or more, by two producers in August and by another supplier in September. Major efforts to reduce costs were continued, and productivity improved. Taxes and electric power contracts remained significant issues in Minnesota. A petition for countervailing duty on imports of pellets from Brazil, filed in late 1984 by three domestic producers, was still being considered by the U.S. International Trade Commission in November 1985.

Environmental concerns in the iron ore industry continued to include reclamation and disposal of process water and solid waste, reduction of dust and noise, control of groundshock from blasting, and updating epidemiological studies on the relation of taconite dust to health. Technological research concerned the use of dolomite for production of magnesic fluxed pellets, plasma-arc smelting of iron ore concentrates, direct reduction of pellets using solid fuels, substitution of organic binders for bentonite, and reduction of fuel costs by the use of coke breeze or coal-water slurries.

Owing to increasing use of scrap and continuous casting in manufacture of raw steel, domestic demand for iron ore in 1990 is expected to be essentially unchanged from that in 1983. It is estimated that in 1986, domestic production of iron ore will be 48 million tons and U.S. apparent consumption will be 60 million tons.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 5/	
	1984	1985 e/	Crude Iron Ore (million long tons)	Iron Content (million short tons)
United States	51.3	48.0	24,800	5,900
Australia	88.6	90.0	33,000	20,200
Brazil	88.6	95.0	15,600	10,800
Canada	37.2	38.0	25,100	9,800
France	14.8	14.0	2,200	900
India	40.4	42.0	7,100	4,800
Liberia	14.9	15.0	1,600	800
South Africa, Republic of	24.1	23.0	9,300	6,600
Sweden	17.8	23.0	4,600	2,400
Venezuela	12.5	14.0	2,000	1,200
Other Market Economy Countries	59.0	57.0	12,100	6,200
China e/	74.0	75.0	9,000	3,500
U.S.S.R.	243.1	242.0	59,000	25,000
Other Centrally Planned Economies	23.1	23.0	900	300
World Total (rounded)	789.0	799.0	206,000	98,000

10. World Resources: World resources are estimated to exceed 800 billion long tons of crude ore containing more than 260 billion short tons of iron. U.S. resources are estimated at about 108 billion long tons of ore containing about 30 billion short tons of iron. U.S. resources are mainly low-grade taconite-type ores of the Lake Superior district that require beneficiation and agglomeration for commercial use. U.S. resources include economic reserves estimated at approximately 16 billion long tons of ore containing nearly 4 billion short tons of iron recoverable in concentrate.

11. Substitutes: Iron ore is the only source of primary iron. Small amounts of ferrous scrap may be added to blast furnace burdens. Scrap is extensively used in steelmaking and in iron and steel foundries.

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IRON AND STEEL 1/

(Data in million short tons of metal, unless noted)

1. Domestic Production and Use: In 1985, the iron and steel and ferrous foundry industries produced steel mill products and castings valued at about $50 billion. The steel industry was composed of approximately 86 companies producing raw steel in 131 plants. Pig iron was produced by 14 companies owning 93 blast furnaces. Indiana, Ohio, Pennsylvania, Michigan, and Illinois accounted for over 75% of total raw steel production. The foundry industry included approximately 1,500 ferrous foundries producing gray, malleable, and ductile iron castings and steel castings. End use distribution of domestic iron and steel consumption in 1985 was estimated as follows: Construction, 31%; transportation, 26%; machinery, 19%; oil and gas industry, 7%; and other, 17%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Pig iron:					
Production	73.8	43.3	48.8	52.0	51.0
Shipments 2/	74.2	43.4	49.1	52.2	51.0
Imports for consumption	0.5	0.3	0.2	0.7	0.4
Exports	3/	0.1	3/	0.1	0.1
Consumption, reported	75.0	44.4	50.1	53.2	51.0
Price, dollars per ton, Iron Age composite for year	204.66	213.00	213.00	213.00	213.00
Stocks, yearend, total producer and consumer	0.9	0.6	0.3	0.3	0.3
Steel and cast iron:					
Production of raw steel	120.8	74.6	84.6	92.5	89.0
Shipments: Steel mill products	88.4	61.6	67.6	73.7	73.0
Steel castings	1.8	1.0	0.7	1.0	0.9
Iron castings	12.3	8.5	9.5	11.0	10.2
Imports for consumption of major iron and steel products	20.8	17.4	18.0	27.5	25.5
Exports of major iron and steel products	3.6	2.4	1.6	1.4	1.4
Consumption, apparent	120.3	88.6	92.4	110.9	107.7
Price, finished base, cents per pound, Iron Age composite for year	24.2	25.3	26.2	27.3	27.6
Stocks, steel mill products, yearend; consumer and service center	11.3	8.8	4/11.1	12.0	12.5
Employment, average: 5/					
Blast furnaces and steel mills (SIC 3312)	422,000	325,000	275,000	268,000	255,000
Iron and steel foundries (SIC 332)	201,000	159,000	143,000	157,000	150,000
Net import reliance 6/ as a percent of apparent consumption	15	20	16	23	22

3. Recycling: See Iron and Steel Scrap.

4. Import Sources (1981-84): European Economic Community (EEC) 28%, Japan 28%, Canada 13%, Other 31%. Imports from Latin America and the Republic of Korea increased in 1983 and 1984.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Pig iron 7/	606.13	Free	Free	$1.125/long ton
Structural steel	609.80	0.9% ad val.	0.9% ad val.	2% ad val.

6. Depletion Allowance: Not applicable.

e/ Estimated.
1/ See also Iron Ore and Iron and Steel Scrap.
2/ Includes pig iron transferred directly to steel furnaces at same site.
3/ Less than 50,000 tons.
4/ Revised series beginning in 1983.
5/ Bureau of Labor Statistics.
6/ Defined as imports - exports + adjustments for Government and industry stock changes.
7/ Containing less than: Chromium, 0.2%; molybdenum, 0.1%; tungsten, 0.3%; and vanadium, 0.1%.

Prepared by F. J. Schottman, telephone number (202) 634-1022.

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7. Government Stockpile: None.

8. Events, Trends, and Issues: Apparent consumption of iron and steel was slightly lower in 1985 than in 1984, and despite a reduction in imports because of import restrictions, production and shipments were little changed. Following the same seasonal pattern as in recent years, production peaked in the spring, at about 70% of capability, but declined in late summer, to below 60% of capability. Raw steel capability decreased slightly to 134 million tons per year. About 75% of the capability was provided by integrated companies while the remainder was provided by nonintegrated producers including minimills and specialty steel companies. Prices tended to firm slightly late in the year because of import restrictions, but domestic steel consumers, who faced import competition for their own products, pressed steel producers for lower prices.

Because of low operating rates, many domestic steel companies continued to lose money on steel operations. Several high-cost or under-utilized steel operations were closed. Some companies sold, or were trying to sell, profitable properties in order to improve their financial condition. Companies further reduced employment and reduced compensation for some employees. The seventh largest steel company filed for bankruptcy and attempted to reorganize. After a bankruptcy court allowed the company to void its labor agreement and to unilaterally reduce pay and benefits, the union began the first company-wide strike against a major steel company since 1959. Earlier in the year, the four remaining companies in the steel industry bargaining group decided to conduct separate negotiations with the United Steelworkers of America for 1986 contracts. For about 30 years, the bargaining group had provided nearly uniform labor agreements for most of the steel industry. Finishing of imported semi-finished steel was becoming a significant part of the domestic steel industry. The industry, with some Government support, conducted research on radically new technology for producing iron and for casting thin steel slabs.

Imports of steel decreased slightly in 1985 as import restrictions took effect. As part of a 5-year program to limit imports of steel, restraint agreements were negotiated with most major exporting countries and cases were pursued against allegedly unfairly traded steel from other countries. Agreements were completed with the EEC to cover a variety of products that had not been covered in a 1982 agreement. That agreement was to expire at the end of 1985 and negotiations were conducted late in the year to extend the restrictions.

Total world production of steel increased slightly with the general economic revival. The steel industries in the major market economy industrialized countries were modernizing but not expanding. The EEC continued its plan to reduce market controls and government subsidies to its steel industry.

It is estimated that in 1986 domestic production of raw steel will be 85 million tons and U.S. apparent consumption of iron and steel will be 102 million tons. From a 1983 base, demand for steel is expected to increase at an average annual rate of about 2.0% through 1990.

9. World Pig Iron and Raw Steel Production:

	Pig Iron		Raw Steel	
	1984	1985 e/	1984	1985 e/
United States	52.0	51.0	92.5	89.0
European Economic Community	91.6	93.0	132.4	134.0
Japan	88.6	90.0	116.4	118.0
Other Market Economy Countries	99.1	101.0	147.7	151.0
China	44.1	45.0	47.8	49.0
U.S.S.R.	121.0	122.0	170.0	172.0
Other Centrally Planned Economies	42.8	44.0	72.1	75.0
World Total	539.2	546.0	778.9	788.0

10. World Resources: Not applicable. See Iron Ore.

11. Substitutes: Iron is the least expensive and most widely used metal. In most applications iron and steel compete either with less expensive nonmetallic materials or with more expensive materials having a property advantage. Iron and steel compete with lighter materials such as aluminum and plastics in the motor vehicle industry; with concrete, aluminum, and wood in construction; and with aluminum, glass, plastics, and paper in containers.

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IRON AND STEEL SCRAP 1/

(Data in million short tons of metal, unless noted)

1. Domestic Production and Use: Total estimated value of 1985 domestic purchases and exports was $4.2 billion. The steel industry accounted for about 75% of the domestic scrap consumption, using scrap together with pig iron to produce steel products for the construction, transportation, oil and gas, machinery, container, appliance, and other consumer industries. The ferrous castings industry consumed about 24% of the total consumption to produce cast iron and steel products such as motor blocks, pipe, and machinery parts. Relatively small quantities were used for producing ferroalloys, for the precipitation of copper, and by the chemical industry; these uses totaled less than 1 million tons.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Home scrap	43.8	27.1	27.2	29.2	29.0
Purchased scrap 2/	47.8	34.4	41.3	45.0	47.6
Imports for consumption	0.6	0.5	0.6	0.6	0.6
Exports 3/	6.4	6.9	7.7	9.5	8.7
Consumption: Reported	85.1	56.4	61.8	65.7	71.0
Apparent	85.7	56.8	62.0	65.8	69.0
Price, average, dollars per gross ton delivered: No. 1 Heavy Melting composite price, Iron Age average: Pittsburgh, Philadelphia, Chicago	91.33	63.73	72.91	86.46	76.20
Stocks, consumer, yearend	8.1	6.4	5.8	5.3	4.8
Employment, dealers, brokers, processors e/	25,000	24,000	22,500	21,500	21,000
Net import reliance 4/ as a percent of apparent consumption	Net exporter				

3. Recycling: All iron and steel scrap is recycled material, consisting of about one-half home scrap, one-fourth prompt industrial scrap, and one-fourth old (obsolete) scrap.

4. Import Sources (1981-84): Canada 89%, Other 11%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Iron and steel waste and scrap:				
Tin plate waste or scrap	606.08	Free	Free	Free
Other				
Not containing over 0.2% Cr, 0.1% Mo, 0.3% W, or 0.1% V	606.09	Free	Free	75¢/long ton
Containing over 0.2% Cr, 0.1% Mo, 0.3% W, or 0.1% V	606.11	Free	Free	0.5% ad val. plus additional duties

6. Depletion Allowance: Not applicable.

7. Government Stockpile: None.

e/ Estimated.
1/ See also Iron Ore and Iron and Steel.
2/ Receipts minus shipments by consumers, plus exports minus imports.
3/ Includes rerolling material and ships, boats, and other vessels for scrapping.
4/ Defined as imports - exports + adjustments for Government and industry stock changes.

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8. Events, Trends, and Issues: Through July 1985, raw steel production at 62.1% of productive capability was 30.0 million tons compared with 33.1 million tons at 74.6% of productive capability in the first 7 months of 1984. In January 1985, total steel shipments for 1985 were projected to be 77.8 million tons. The domestic ferrous castings industry in the first 7 months of 1985 shipped 6.1 million tons of all types of iron castings, 7.6% less than in the same time period in 1984, while the 554,000 tons of steel castings shipments were 1.1% more than the 548,000 tons shipped in the first 7 months of 1984. On June 30, 1985, stocks of ferrous scrap held by the three major types of domestic consumers were 5.01 million tons, 249,000 tons less than on June 30, 1984. Composite prices quoted by Iron Age on a gross ton delivered basis of No. 1 Heavy Melting steel scrap to domestic purchasers in the first 8 months of 1985 averaged $76.20, ranging from $86.75 in March to $66.34 in June. In the first 8 months of 1984, this grade of scrap averaged $88.43, ranging from $94.92 in February to $81.90 in July.

   A comparison of data for the first 5 months of 1985 and 1984 indicates that receipts of ferrous scrap by all domestic consumers from brokers, dealers, and other outside sources in 1985 were 16.5 million tons valued at $1.4 billion ($84.70 per ton) and 16.7 million tons tons valued at $1.4 billion ($81.15 per ton) in 1984.

   In the first 5 months of 1985, the delivered cost of ferrous scrap received from brokers, dealers, and other outside sources by steel mills approximated $27 per ton of raw steel produced; manufacturers of steel castings paid approximately $139 per ton of castings shipped; and the iron castings industry paid approximately $70 per ton of castings shipped, excluding ingot molds and stools made using blast furnace hot metal.

   Exports of all grades of ferrous scrap in the first 5 months of 1985 totaled 3.64 million tons valued at $351.8 million ($96.65 per ton) compared with 3.48 million tons valued at $327.7 million ($90.03 per ton) in the first 5 months of 1984.

   Congress passed the Shipping Act of 1984, S.38, giving scrap exporters a tariff-filing exemption formerly given only to bulk-cargo shippers. The legislation excluded dismantlers, who were not engaged in water-borne commerce, from current and unnecessary provisions. The President signed this legislation, titled the Longshore and Harbor Workers' Compensation Amendments of 1984, on September 28, 1985. In late June the President signed compromise legislation (S.883) to reauthorize the Export Administration Act. The law includes limited contract sanctity, clarifies the foreign availability test and requires the President to consult with an affected industry before imposing foreign policy controls. The International Trade Commission unanimously approved the acquisition of a barge line by a U.S. railroad corporation, the first merger of a railroad and a barge line. Congress amended the Resource Conservation and Recovery Act of 1980, thereby requiring all Federal Government agencies to maximize the procurement of goods from recycled materials.

   It is estimated that in 1986, domestic net receipts of scrap plus exports will total 47.0 million tons and the apparent U.S. consumption will be 73.8 million tons. From a 1983 base, demand for ferrous scrap is expected to increase at an average annual rate of approximately 2.0% to 1990.

9. World Mine Production and Reserve Base: Not applicable.

10. World Resources: Not applicable.

11. Substitutes: Approximately 320,000 tons of direct reduced iron, a potential substitute for iron and steel scrap, was used in the United States in 1985.

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IRON AND STEEL SLAG

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: In 1985, an estimated 21 million tons of iron and steel slags, byproducts of iron and steelmaking, valued at $104 million were sold or used. About 76% of this was iron slag with an f.o.b. value of $86 million, and the balance was steel slag with an f.o.b. value of $18 million. Iron blast furnace slags were processed at 37 facilities in 13 States and consisted of air cooled, expanded, and granulated types. Steel slags, from open hearth, basic oxygen, and electric furnaces, were processed at 48 facilities located in 20 States. About 54% of the Nation's iron and steel slags were produced in Pennsylvania, Indiana, and Ohio. Iron and steel slags were mainly used as construction materials, with iron slag being typically used as road base, fill, concrete aggregate, and asphaltic concrete aggregate, comprising about 52%, 10%, 9%, and 8% of total end use, respectively, and steel slag being mainly used as road base, 49%; fill, 20%; and asphaltic concrete aggregate, 10%. Of all iron and steel slag products shipped, 90% traveled by truck with an average marketing range of 24 miles, 6% traveled by rail with an average marketing range of 181 miles, and 3% traveled by waterway with an average marketing range of 404 miles. The remaining 1% was used at plantsite.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, marketable	21,487	19,516	18,386	22,063	21,000
Imports for consumption		Not available 1/			
Exports		Not available 1/			
Consumption: Apparent		Not available			
Estimated	21,487	19,516	18,386	22,063	21,000
Price, average value, dollars per ton, f.o.b. plant	3.93	4.07	4.31	4.66	4.96
Stocks, yearend		Not available			
Employment, processing plant e/	1,000	1,000	1,000	1,000	1,000
Net import reliance 2/ as a percent of apparent consumption		Not available			

3. Recycling: Before processing, some steel slag is recycled to blast furnaces, directly or as agglomerates, as a source of iron and flux materials. An estimated 3.1 million tons of steel slag was recycled to blast furnaces in 1985. Ferrous scrap, recovered from slag during processing, is also recycled to blast and steel furnaces.

4. Import Sources (1981-84): Not available. 1/ However, minor amounts of granulated blast furnace slag are received from France and Japan for use in the production of high grade cement. Blast furnace slag is exported to and imported from Canada periodically. Minor amounts of basic slag were imported from Canada and Japan and exported to Italy and Mexico for use as fertilizer.

5. Tariff: None.

6. Depletion Allowance: Not applicable.

7. Government Stockpile: None.

e/ Estimated.
1/ Included in blanket Tariff Schedule categories.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.

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8. Events, Trends, and Issues: Sales and use of iron and steel slag were slightly lower than in 1984. This was due to a slackening of consumer demand for construction purposes and a reduced supply of slag available to some processors because of decreased iron and steel production. The average price of iron and steel slag sold in 1985 increased about 6% reflecting higher processing costs. From a 1983 base, demand for iron and steel slag is expected to increase at an average annual rate of about 2% through 1990. It is estimated that in 1986 domestic marketable production and U.S. consumption of iron and steel slag will be 20 million tons.

   Essentially all iron slag produced is used. Most salable iron slag banks in the United States have been worked, so availability of iron slag is largely dependent on current production. However, steel slag banks contain large, undetermined tonnages because of smaller markets. Adverse physical and chemical properties, such as volume change problems because of high lime content, have limited the use of steel slag in many structural applications. Proper selection, processing, aging, and improved technology have broadened steel slag potential usage though, and steel slag sales, as a percentage of total slag sales, are expected to increase in the future. The construction industry continues to be the principal user of iron and steel slag. Besides traditional uses, large increases are expected in the use of granulated blast furnace slag as a replacement for cement because of savings in the natural resources and energy required to manufacture cement clinker. Also, iron slag is being used increasingly in bituminous mixtures and in lightweight concrete applications. Steel slag usage for concrete aggregate is also expected to be a major growth area.

9. World Mine Production and Reserve Base: Not applicable.

10. World Resources: Not applicable.

11. Substitutes: Sand, gravel, and crushed stone for construction materials are the predominant substitutes for iron and steel slags.

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KYANITE AND RELATED MINERALS
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Two firms, in Virginia and Georgia, each with coordinated mining and processing operations, supplied all of the kyanite production. The material was from hard rock open pit mines. Synthetic mullite was believed to have been produced by three companies in Alabama, Georgia, and New York. It was estimated that 90% of the kyanite-mullite output was used in refractories--55% for smelting and processing ferrous metals, 20% for nonferrous metals, and 15% for glassmaking and ceramics. Nonrefractory uses accounted for the balance.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Mine	W	W	W	W	W
Synthetic mullite	42	27	e/23	e/27	27
Imports for consumption	NA	NA	NA	e/6	NA
Exports e/	45	40	40	45	45
Shipments from Govt. stockpile excesses			None		
Consumption, apparent	W	W	W	W	W
Price: Domestic concentrate, from 35- to 325-mesh sizes, raw bulk, f.o.b. Georgia, $92 to $144 per ton, (bagged material $9 extra); imported kyanite, no current quotation; synthetic mullite, $150 to $1,500 per ton, depending upon type and grade.					
Stocks, producer			Not available		
Employment, kyanite mine and plant e/	200	200	200	200	200
Net import reliance 1/ as a percent of apparent consumption			Net exporter		

3. Recycling: Insignificant.

4. Import Sources (1981-84): Not available after 1977 from Bureau of the Census. Estimated imports in 1984 were 6,000 tons of andalusite from the Republic of South Africa.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Kyanite, sillimanite, andalusite, and dumortierite	523.81	Free	Free	Free
Mullite	523.91	5.2% ad val.	4.9% ad val.	30% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: In addition to quantity shown below, the stockpile contains 1,047 tons of nonstockpile-grade material.

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Kyanite, lump	-	0.1	-	-

e/ Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ See page 182 for definitions.
3/ Excluding United States and Centrally Planned Economies.

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8. Events, Trends, and Issues: U.S. consumption of kyanite and synthetic mullite was estimated to be about the same as in 1984. From a 1983 base, demand for kyanite/synthetic mullite is expected to increase at an average annual rate of about 2% through 1990. Estimated domestic mine production and U.S. apparent consumption of kyanite/synthetic mullite in 1986 are withheld to avoid disclosing company proprietary data. It is estimated that in 1986 U.S. production of synthetic mullite will be 30,000 tons.

There has been a trend in recent years toward higher quality refractories, such as those based on kyanite and mullite, resulting in longer furnace lives for the refractories. As a result, consumption of refractories in, for example, the iron and steel and other metallurgical industries has decreased.

There continues to be a need for research in such areas as improved methods of ore beneficiation and quality control.

9. World Mine Production and Reserve Base:

	Mine Production e/		Reserve Base 2/
	1984	1985	
United States	W	W	Large in the United States and the Republic of South Africa; assumed to be large in other countries.
France	33	35	
India	55	55	
South Africa, Republic of	157	160	
Other Market Economy Countries	12	10	
Centrally Planned Economies	NA	NA	
World Total 3/	257	260	

10. World Resources: Immense resources of kyanite and related minerals known to exist in the United States should permit the increase in production needed to meet the demand expected during the next 15 years. The chief resources are in deposits of micaceous schist and gneiss, mostly in the Appalachian area and in Idaho. These resources are not economical at present, but some may be eventually. The characteristics of kyanite resources in the rest of the world are believed to be similar to those in the United States.

11. Substitutes: Two types of synthetic mullite (fused and sintered), superduty fire clays, and high-alumina materials are substitutes for kyanite in refractories. Principal raw materials for both types of synthetic mullite are bauxite, kaolin and other clays, and silica sand.

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LEAD

(Data in thousand metric tons of lead, unless noted)

1. Domestic Production and Use: The value of mine production in 1985, based on the average U.S. producer price, was $168 million. Seven lead mines in Missouri yielded about 90% of the total, and lead-producing mines in Colorado, Idaho, Montana, and New York contributed about 10%. A fraction of 1% was divided among producers in Arizona, California, Illinois, Nevada, New Mexico, Tennessee, and Utah as a coproduct or byproduct of zinc, silver, gold, fluorspar, or copper mining. Primary lead was smelted and refined at six plants in Missouri, Texas, Montana, and Nebraska. Over 95% of secondary production came from 30 plants located throughout the country with annual capacities greater than 5,000 tons. Lead was consumed by approximately 350 firms. Transportation accounted for the major end use with 73% used in batteries, gasoline additives, and other applications. Consumption for construction, ammunition, electrical, TV glass, and paint was 23% of the total, with the balance for ceramics, ballast or weights, tubes or containers, type metal, and other small uses.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Mine, recoverable content	446	512	449	322	400
Primary refinery	498	517	515	396	510
Secondary refinery	641	571	504	583	525
Imports for consumption: Lead in concentrates	27	19	20	30	3
Metal, including scrap	104	100	181	168	115
Exports: Lead in concentrates	33	29	24	21	20
Metal, including scrap	59	87	51	34	75
Consumption: Reported	1,167	1,075	1,149	1,207	1,100
Apparent	1,040	1,068	1,039	1,014	880
Price, average, cents per pound: U.S.	36.5	25.5	21.7	25.6	19
London	33.3	24.7	19.3	20.1	18
Stocks, metal, producers/consumers, yearend	195	165	153	139	162
Employment: Mine and mill	3,900	3,500	3,200	2,200	2,000
Primary smelters/refineries	1,400	1,400	1,400	1,100	1,000
Secondary smelters/refineries	2,100	2,000	1,600	1,700	1,500
Net import reliance 1/ as a percent of apparent consumption	1	3	14	16	0

3. Recycling: Recovery of lead from old scrap was approximately 480,000 tons.

4. Import Sources (1981-84): Lead in concentrates--Peru 56%, Honduras 27%, Canada 4%, Mexico 4%, Other 9%.
Metal, including scrap--Canada 50%, Mexico 25%, Australia 8%, Peru 6%, Other 11%.

5. Tariff: In 1985, lead concentrates imported from Honduras and Mexico, and waste or scrap imported from Mexico and Peru, were duty free.

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Concentrates	602.10	0.75¢/lb, lead content	0.75¢/lb, lead content	1.5¢/lb
Unwrought lead	624.03	3.0% ad val., lead cont.2/	3.0% ad val., lead cont.2/	10.0% ad val.
Waste and scrap	624.04	2.5% ad val., lead cont.	2.3% ad val., lead cont.	11.5% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile:

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Lead	998	545	-	--

e/ Estimated.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ Total rate not to be less than 1.0625¢/lb.
3/ See page 182 for definitions.

Prepared by W. D. Woodbury, telephone number (202) 634-1083.

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8. Events, Trends, and Issues: Refinery capacity utilization in the lead industry during 1985 was 86% in the primary sector and 60% in the secondary sector, the latter being the highest rate since 1979. However, five secondary plants totaling 200,000 tons of capacity closed indefinitely during the year. About 550,000 tons of secondary capacity has closed since 1979. Domestic mine production during the year increased 24% compared with strike-bound 1984, but was still the second lowest level since 1968, the year before the Viburnum Trend mines in Missouri achieved full production capabilities. A major new mine with an eventual capacity of 46,000 tons per year opened in Missouri in the last quarter, but one of the Nation's five primary smelters closed indefinitely in mid-September due to the lack of an assured supply of imported concentrate.

The U.S. producer and London Metal Exchange (LME) prices for lead were 20 and 19 cents per pound, respectively, at the beginning of 1985. The prices declined gradually to about 18 and 16 cents per pound, respectively, through March, but increased to 20 and 19 cents by May. From June through December the U.S. and LME prices hovered around 19 and 18 cents per pound, respectively. The prices reflected a generally static worldwide supply-demand relationship.

It is estimated that in 1986 domestic mine production of lead will be 400,000 tons and U.S. apparent consumption will be 900,000 tons. From a 1983 base, demand for lead is expected to increase at an average annual rate of about 1.3% through 1990. The growth in lead use is contingent on the development of cost-competitive and reliable electric vehicles for general and new industrial uses, major power supply load-leveling applications, and continuing high growth for uninterrupted power supply systems.

On July 1, 1985, the permissible amount of lead additives in gasoline was reduced by over 50% to 0.5 gram per gallon. On January 1, 1986, the standard becomes 0.1 gram per gallon, a reduction of over 90% from the 1982 standard of 1.1 grams per gallon. At yearend, a total ban by 1988 was being considered by the Environmental Protection Agency.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 3/
	1984	1985 e/	
United States	322	400	27,000
Australia	446	480	28,000
Canada	260	280	17,000
Mexico	195	200	4,000
Morocco	101	100	4,000
Peru	196	200	4,000
South Africa, Republic of	95	100	5,000
Yugoslavia	100	100	5,000
Other Market Economy Countries	620	620	21,000
Centrally Planned Economies	865	870	28,000
World Total	3,200	3,350	143,000

10. World Resources: In recent years significant reserves of lead have been discovered associated with zinc and silver ores in Alaska, Canada, Mexico, Australia, and the Republic of South Africa. The identified subeconomic lead resources of the world are estimated at about 1.4 billion tons. Much of this resource is in low-tenor or unconventional deposits that need new technology for development and recovery, but the prospect for finding additional resources of conventional deposits at a rate exceeding consumption is highly favorable.

11. Substitutes: Substitution by plastics has reduced the use of lead in building construction, electrical cable covering, and in cans and containers. Aluminum, tin, iron, and plastics compete with lead in other packaging and protective coatings.

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LIME 1/ 2/
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: In 1985, lime producers at 132 plants in 38 States sold or used 15.8 million tons of lime valued at $798 million, a slight decrease in tonnage and value compared with that of 1984. Open-market sales decreased 1% to 13 million tons. Captive lime used by producers decreased 6% to 2.7 million tons, 63% below the record year of 1971. Ten companies, operating 30 plants, accounted for 52% of the output. Principal producing States were Ohio, Pennsylvania, Missouri, Kentucky, Alabama, and Texas. Each produced over 1 million tons, and together accounted for 56% of the output. The leading individual uses for lime were in steel furnaces, water treatment, construction, sulfur removal from stack gases, and paper and pulp. Dead-burned dolomite was in decreasing demand for refractories, with only four producing plants. Sales for iron and steel were 35%, environmental uses, 22%; other chemical and industrial uses, 30%; construction, 9%; and refractories and agriculture, 4%. Chemical and industrial sales were down 1%, construction sales increased 5%, refractory sales were down 26%, and sales of lime for agriculture increased 30% compared with 1984.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production	18,856	14,075	14,867	15,922	15,800
Imports for consumption	504	348	283	247	200
Exports	28	23	28	25	20
Consumption, apparent	19,332	14,400	15,122	16,144	15,980
Price, dollars per ton at plant, average	46.89	49.46	50.96	50.95	50.50
Stocks, yearend		Not available			
Employment, mine and plant	6,500	5,200	5,300	5,500	5,500
Net import reliance 3/ as a percent of apparent consumption	2	2	2	1	1

3. Recycling: Large quantities of lime are regenerated by paper mills, carbide plants, and some municipal water treatment plants. Data for these plants are not included as production, in order to avoid duplication.

4. Import Sources (1981-84): Canada 88%, Mexico 12%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Hydrated	512.11	Free	Free	4/12¢/100 lb
Other	512.14	Free	Free	4/10¢/100 lb

6. Depletion Allowance: 14% (Domestic), 14% (Foreign), for limestone produced and used for lime production.

7. Government Stockpile: None.

e/ Estimated.
1/ Data are for quicklime, hydrated lime, and refractory dead-burned dolomite.
2/ Excludes Puerto Rico, unless noted.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ Rates include weight of container.
5/ See page 182 for definitions.
6/ Includes Puerto Rico.

Prepared by J. W. Pressler, telephone number (202) 634-1206.

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8. Events, Trends, and Issues: Sales for environmental uses increased 2% compared with that of 1984. Environmental regulations increased total lime demand for desulfurization of stack gases of thermal powerplants, smelters, refineries, chemical plants, and for neutralizing industrial effluent water and solid wastes to 3.6 million tons. Captive use was down 6%, influenced by the iron and steel industry's trend towards purchases of lime on the open-market, and by the malaise in the copper industry. Estimated shipments, sold or used, represented 80% utilization of national capacity. From a 1983 base, demand for lime is expected to increase at an average annual rate of about 3.7% through 1990. It is estimated that in 1986 domestic production of lime will be 16.4 million tons and U.S. apparent consumption will be 16.7 million tons.

The lime industry is energy intensive, averaging about 6.7 million Btu per ton of lime produced in 1984; cost of this energy averaged $13.90 per ton of lime. About 78% of the industry used coal, 14% used natural gas, and 8% used petroleum coke and oil. Natural gas was 50% to 100% more expensive than coal in most areas. Current trends indicate a greater use of coal.

9. World Lime Production and Limestone Reserve Base:

	Production		Reserve Base 5/
	1984	1985 e/	
United States 6/	15,956	15,800	
Belgium	1,786	1,800	
Brazil	5,500	5,400	
Canada	2,510	2,400	
France	3,300	3,300	Adequate for
Germany, Federal Republic of	7,900	7,800	all countries
Italy	2,300	2,300	listed
Japan	8,547	8,500	
Mexico	4,400	4,300	
United Kingdom	3,400	3,400	
Yugoslavia	2,200	2,200	
Other Market Economy Countries	14,859	14,800	
Czechoslovakia	3,436	3,500	
German Democratic Republic	3,900e	3,800	
Poland	4,600	4,500	
Romania	4,100	4,100	
U.S.S.R.	33,100	33,100	
Other Centrally Planned Economies	3,002	3,000	
World Total	124,796	124,000	

10. World Resources: Domestic and world resources of limestone and dolomite suitable for lime manufacture are adequate.

11. Substitutes: Limestone is a substitute for lime for many uses such as agriculture, fluxing, and sulfur removal. Although slower to react, limestone is considerably cheaper than calcined energy-intensive lime. Calcined gypsum is an alternate material in industrial plasters and mortars. Cement and lime kiln dust and fly ash are potential resources as substitutes for some construction uses of lime.

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LITHIUM

(Data in short tons of contained lithium, unless noted)

1. **Domestic Production and Use:** The United States was the world's leading producer and consumer of lithium minerals and compounds. The value of domestic production of lithium compounds was estimated to be about $98 million in 1985. Two companies accounted for all of U.S. production and exported lithium to most of the market economy countries. One of these companies underwent a change in ownership during the year.

   The largest end use for lithium was in aluminum potlines, accounting for an estimated 30% of domestic consumption. Other major applications of lithium were glass and ceramics manufacture and lubricants, which together accounted for approximately 40% of domestic demand.

2. **Salient Statistics--United States:**

	1981	1982	1983	1984	1985 e/
Production	W	W	W	W	W
Imports for consumption	150	30	35	90	300
Exports	2,600	2,300	2,600	2,900	2,600
Consumption: Apparent	W	W	W	W	W
Estimated 1/	3,200	2,000	2,200	3,200	3,500
Price, yearend, dollars per pound:					
Lithium carbonate	1.41	1.41	1.48	1.54	1.54
Lithium hydroxide monohydrate	1.84	1.84	1.93	1.93	1.93
Stocks, producer, yearend	W	W	W	W	W
Employment, mine and mill e/	375	340	300	300	275
Net import reliance 2/ as a percent of apparent consumption	Net exporter				

3. **Recycling:** None.

4. **Import Sources (1981-84):** China 54%, Chile 35%, Federal Republic of Germany 7%, Other 4%.

5. **Tariff:**

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Mineral concentrates	523.31	Free	Free	Free
Metal	415.30	7.3% ad val.	6.6% ad val.	25% ad val.
Salts	426.46	5.0% ad val.	5.0% ad val.	25% ad val.
Compounds	419.10	3.9% ad val.	3.7% ad val.	25% ad val.

6. **Depletion Allowance:** 22% (Domestic), 14% (Foreign).

7. **Government Stockpile:** None.

e/ Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
1/ Based primarily on monitoring at the concentrate stage and assuming a 15% lithium loss during conversion of concentrate to chemicals.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 182 for definitions.
4/ These estimates denote only an approximate order of magnitude, no basis for more exact estimates is available. Output by China and the U.S.S.R. has never been reported.
5/ Excluding U.S. production.

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8. Events, Trends, and Issues: The new Chilean lithium carbonate plant completed its first full year operating near capacity. The operation is under a limited partnership owned 55% by a U.S. lithium producer and 45% by the Chilean Government's development company. In a second potentially significant development in Chile, another U.S. company operating under a different limited partnership with a Chilean molybdenum producer considered a proposed new potash, boric acid, and lithium venture. This project would use brine from the same large salar as the new lithium carbonate plant. In order to meet the forecasted potash production capacity, a volume of brine would be required that would contain approximately 50,000 tons per year of lithium metal equivalent. If fully recoverable, this quantity of lithium is eight to nine times the current estimated world demand. One of the issues being negotiated between the U.S. company and the Government of Chile was the size of the lithium concession.

Competition also intensified for the world lithium mineral market as companies from Australia, Canada, the United States, and Zimbabwe vied for this lithium market. The company from Australia also undertook a cooperative study with a Japanese trading company and a lithium chemicals producer from the Federal Republic of Germany to consider entering the lithium carbonate market.

Development of aluminum-lithium alloys for aerospace applications continued to show promise as an emerging major lithium end use. The new alloys, which contain 2% to 3% lithium, were 6% to 12% lower in density than aluminum, and could reduce the inroads of lightweight composites into the aircraft aluminum market. One U.S. aluminum company was expanding its aluminum-lithium casting facility, with capacity for casting individual 60,000-pound ingots expected to be completed by yearend.

From a 1983 base, demand for lithium is expected to increase at an average annual rate of about 8.9% through 1990. It is estimated that in 1986 U.S. consumption of lithium will be 3,600 tons.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 3/
	1984	1985 e/	
United States	W	W	450,000
Argentina e/	1	1	NA
Australia e/	234	300	350,000
Bolivia	-	-	6,000,000
Brazil	11	10	NA
Canada	-	150	400,000
Chile	530	1,000	1,500,000
Namibia e/	15	15	NA
Portugal	5	5	NA
Zaire	-	-	350,000
Zimbabwe	175	200	30,000
China 4/	500	500	NA
U.S.S.R. 4/	1,800	1,800	NA
World Total (rounded)	5/3,300	5/4,000	9,100,000

10. World Resources: The identified lithium resources total 0.86 million tons in the United States and 7.2 million tons in the other market economy countries.

11. Substitutes: Substitutes for lithium compounds are possible in manufactured glass, ceramics, greases, and batteries. Examples are sodic and potassic fluxes in ceramic and glass manufacture; calcium and aluminum soaps as substitutes for lithium stearates in greases; and zinc, magnesium, calcium, and mercury as anode material in primary batteries. Lithium carbonate can be reduced or excluded in aluminum potlines by increasing the percentages of cryolite, calcium fluoride, and aluminum fluoride.

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MAGNESIUM METAL 1/
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: During 1985, three companies produced magnesium metal, which had a total value of over $400 million. Two of the companies produced metal by electrolytic methods. One at Freeport, TX, used seawater as its raw material, and the other in Rowley, UT, used the brines of the Great Salt Lake. The third company produced metal from dolomite mined in Washington by the silicothermic method. Fifty-four percent of the metal was used for the manufacture of aluminum-base alloys. Magnesium castings and wrought products accounted for 16%; reducing agent, 7%; cathodic protection, 5%; manufacture of nodular cast iron, 3%; and other uses, 15%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Primary	154	102	115	159	150
Secondary	46	43	46	48	50
Imports for consumption	7	5	6	9	9
Exports	35	40	47	48	45
Consumption: Reported, primary	91	75	82	90	95
Apparent 2/	136	107	117	140	140
Price, dollars per pound	1.25-1.34	1.34	1.38	1.43-1.48	1.48
Stocks, producer and consumer, yearend	63	46	28	35	35
Employment e/	600	500	500	500	500
Net import reliance 3/ as a percent of apparent consumption			Net exporter		

3. Recycling: In 1985, about 26,000 tons of the reported metal consumption was from old scrap.

4. Import Sources (1981-84): Norway 27%, Canada 23%, France 11%, Italy 11%, Other 28%.

5. Tariff:

	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Unwrought metal	628.55	10.0% ad val.	8.0% ad val.	100% ad val.
Unwrought alloys	628.57	6.6% ad val.	6.5% ad val.	60.5% ad val.
Wrought metal	628.59	4.7¢/lb on Mg content + 2.6% ad val.	4.5¢/lb on Mg content + 2.5% ad val.	40¢/lb on Mg content + 20.0% ad val.

6. Depletion Allowance: Dolomite 14% (Domestic and Foreign); magnesium chloride 5% (Domestic and Foreign).

7. Government Stockpile: None.

e/ Estimated.
1/ See also Magnesium Compounds.
2/ Domestic primary metal production plus recovery from old scrap, and net import reliance.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ See page 182 for definitions.

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8. Events, Trends, and Issues: Metal prices remained stable throughout 1985, with primary magnesium ingot quoted at $1.48 per pound and diecasting alloy quoted at $1.26 to $1.30 per pound. Demand for magnesium remained strong, especially in diecasting and iron and steel desulfurization applications. Several domestic automobile manufacturers announced plans to replace some aluminum components with magnesium, thereby increasing the use of magnesium in the automotive market. A domestic primary producer announced plans to spend $40 million over the next 3 years to modernize its magnesium facilities. The modernization includes new technology to improve energy efficiency, labor productivity, raw material yields, and product quality.

A Norwegian magnesium producer reportedly will conduct a feasibility study on the construction of a 55,000-ton-per-year magnesium plant in Canada. If the project is deemed viable, construction could begin in late 1986.

It is estimated that in 1986 domestic production and consumption of magnesium metal will remain at about the same levels as in 1985. From a 1983 base, the demand for primary magnesium metal is expected to increase at an average annual rate of about 4% through 1990.

9. World Production and Reserve Base:

	Production		Reserve Base 4/
	1984	1985 e/	
United States	159	150	Since domestic magnesium metal production is derived from natural brines and dolomite, the reserve base for this metal is sufficient to supply current and future requirements. To a limited degree the existing natural brines may be considered a renewable resource wherein any magnesium removed by man can be renewed by nature in a short span of time.
Canada	9	9	
France	12	12	
Italy	8	10	
Japan	8	8	
Norway	55	60	
Yugoslavia	5	5	
China	8	8	
U.S.S.R.	94	95	
World Total	358	357	

10. World Resources: Resources from which magnesium metal may be recovered range from large to virtually unlimited and are globally widespread. Resources of dolomite, and magnesium-bearing evaporite minerals are enormous; magnesium-bearing brines are estimated to constitute a resource in billions of tons; and magnesium can be recovered from seawater at places along world coast lines where salinity is highest.

11. Substitutes: Aluminum and zinc may be substituted for magnesium castings and wrought products.

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MAGNESIUM COMPOUNDS 1/

(Data in thousand short tons of magnesium content, unless noted)

1. Domestic Production and Use: Production of magnesium compounds in 1985 decreased from the previous year. Total production was valued at about $200 million. Magnesium oxide and other compounds were produced by six companies from seawater in California, Delaware, Florida, and Texas; by three companies from well brines in Michigan; and by two companies from lake brines in Utah. One company in Nevada mined magnesite, and two companies in North Carolina and Washington mined olivine. Over 50% of the magnesium compounds produced in the United States were recovered from seawater and well and lake brines. Almost 80% of the consumption of magnesium compounds was for the production of basic refractories used in high-temperature metallurgical furnaces, and the remainder was used to prepare caustic-calcined and specified magnesias.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production	761	564	607	653	630
Imports for consumption	51	44	67	126	150
Exports	35	22	17	30	20
Consumption, apparent	777	586	657	749	760
Stocks, producer, yearend		Not available			
Employment, plant	1,000	900	900	850	850
Net import reliance 2/ as a percent of apparent consumption	2	4	8	13	17

3. Recycling: None.

4. Import Sources (1981-84): Greece 24%, Ireland 23%, Canada 17%, China 12%, Other 24%.

5. Tariff: 3/

	Number	Most Favored Nation (MFN)		Non-MFN
		1/1/86	1/1/87	1/1/86
Crude magnesite	522.61	$0.33/ton	Free	$10.50/ton
Caustic-calcined magnesite	522.64	$2.10/ton	$2.10/ton	$21.00/ton
Refractory magnesia (containing under 4% lime)	531.01	0.16¢/lb	0.16¢/lb	0.75¢/lb
Refractory magnesia (containing over 4% lime)	531.04	6.0% ad val.	6.0% ad val.	30.0% ad val.

6. Depletion Allowance: Brucite 10% (Domestic and Foreign); dolomite and magnesium carbonate 14% (Domestic and Foreign); magnesium chloride 5% (Domestic and Foreign); and olivine 22% (Domestic) and 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
1/ See also Magnesium Metal.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ Tariffs are based on gross weight.
4/ See page 182 for definitions.
5/ Excluding U.S. production.

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8. Events, Trends, and Issues: Over the past 5 years, the U.S. import dependence for magnesium compounds has increased significantly. Domestic production of refractory magnesia continued to decline, although demand increased. This demand was met in part by an increase in imports, primarily from Canada. It was estimated that in 1985 the magnesium compounds industry operated at slightly less than 70% of installed capacity. It is estimated that in 1986 domestic production of magnesium compounds from all sources will be 650,000 tons and U.S. apparent consumption will be 750,000 tons. From a 1983 base, demand for magnesium compounds is expected to increase at an average annual rate of less than 1% through 1990.

9. World Production and Reserve Base:

	Magnesite Production		Reserve Base 4/	
	1984	1985 e/	Magnesite	Well and lake brines and seawater
United States	W	W	10,000	
Australia	7	10	95,000	
Austria	317	320	15,000	
Brazil	73	80	150,000	
Canada	22	25	30,000	
Greece	238	250	30,000	
India	130	130	30,000	
Turkey	180	180	10,000	
Yugoslavia	97	100	5,000	
Other Market Economy Countries	236	240	350,000	
China	634	640	820,000	
Czechoslovakia	210	220	20,000	
Korea, North	604	600	490,000	
U.S.S.R.	692	700	720,000	
Other Centrally Planned Economies	5	5	10,000	
World Total (may be rounded)	5/3,445	5/3,500	2,800,000	Vast

10. World Resources: Resources from which magnesium compounds may be recovered range from large to virtually unlimited and are globally widespread. Identified world resources of magnesite total 12 billion tons, and of brucite, several million tons. Resources of dolomite, forsterite, and magnesium-bearing evaporite minerals are enormous; magnesia-bearing brines are estimated to constitute a resource in billions of tons; and magnesium hydroxide can be recovered from seawater at places along world coast lines where salinity is highest.

11. Substitutes: Alumina, silica, and chromite can be substituted for magnesia in some refractory applications.

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MANGANESE

(Data in thousand short tons, gross weight, unless noted)

1. Domestic Production and Use: No manganese ore containing 35% or more manganese was domestically produced in 1985. Most manganese ore was consumed by about 20 firms with plants located principally in the Eastern and Midwestern United States. A large share of this ore was upgraded to ferroalloys and metal for use in steel production. Most of the remaining ore was used in producing pig iron and dry cell batteries, and for various chemical purposes. End uses were construction, 27%; transportation, 22%; machinery, 16%; and other, 35%.

2. Salient Statistics--United States: 1/

	1981	1982	1983	1984	1985 e/
Production, mine 2/			None		
Imports for consumption:					
Manganese ore	639	238	368	338	410
Ferromanganese	671	493	342	409	350
Exports: Manganese ore	65	29	19	238	40
Ferromanganese	15	10	8	7	8
Shipments from Govt. stockpile excesses: 3/ Manganese ore	293	62	74	65	185
Ferromanganese	-	-	-	(24)	(40)
Consumption, reported: 4/					
Manganese ore	1,077	609	531	627	580
Ferromanganese	821	439	446	492	470
Consumption, apparent, manganese 5/	1,027	672	668	627	670
Price, average value, 46%-48% Mn metallurgical ore, dollars per L.T.U. cont. Mn, c.i.f. U.S. ports	1.72	1.58	1.38	1.42	1.43
Stocks, producer and consumer, yearend:					
Manganese ore	1,036	751	617	582	480
Ferromanganese	202	243	195	159	175
Net import reliance 6/ as a percent of apparent consumption	98	99	99	98	100

3. Recycling: Scrap recovery specifically for manganese was insignificant. However, considerable manganese was recycled through processing operations as a minor component of ferrous and nonferrous scrap and steelplant slag.

4. Import Sources (1981-84): 1/
   Manganese ore - Gabon 33%, Republic of South Africa 27%, Brazil 16%, Other 24%.
   Ferromanganese - Republic of South Africa 39%, France 28%, Other 33%.
   Manganese contained in all manganese imports - Republic of South Africa 33%, France 16%, Brazil 10%, Gabon 10%, Other 31%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Ore and concentrate	601.27	Free	Free	1¢/lb. of contained Mn
High-carbon ferromanganese	606.30	1.5% ad val.	1.5% ad val.	10.5% ad val.
Metal	632.30	14% ad val.	14% ad val.	20% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimated.
1/ Manganese content typically ranges from 35% to 54% for manganese ore and from 74% to 95% for ferromanganese.
2/ Excludes manganiferous ore containing less than 35% manganese, which accounts for about 2% or less of apparent consumption of manganese.
3/ Net quantity including effect of stockpile upgrading program. Data in parentheses denote an increase in inventories.
4/ Total manganese consumption cannot be approximated from consumption of manganese ore and ferromanganese because of the use of ore in making manganese ferroalloys and metal.
5/ Thousand short tons, manganese content. Based on estimates of average content for all significant components except imports, for which content is reported.
6/ Defined as imports - exports + adjustments for Government and industry stock changes.
7/ See page 182 for definitions.

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7. Government Stockpile: Data tabulated below pertain to uncommitted inventories of stockpile-grade material. The stockpile contained further quantities of natural battery ore, chemical ore, and metallurgical ore that had been sold but not yet shipped, and for these kinds of ore also about 34,000 tons, 90 tons, and 943,000 tons, respectively, of nonstockpile-grade material. In September, the General Services Administration extended the contract made in November 1984 for upgrading stockpiled metallurgical ore into high-carbon ferromanganese. The extension was for upgrading 58,600 tons of ore by the end of 1986 in addition to the 80,000 tons of ore being upgraded in 1985.

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Battery: Natural ore	62	172	14	4
Synthetic dioxide	25	3	-	-
Chemical ore	170	172	-	-
Metallurgical ore	2,700	2,279	-	-
Ferromanganese: High-carbon	439	624	-	-
Medium-carbon	-	29	-	-
Silicomanganese	-	24	-	-
Electrolytic metal	-	14	-	-

8. Events, Trends, and Issues: Overcapacity and level price trends persisted. World ore production increased slightly, and purchases by centrally planned economies again spurred output by market economy countries. Civil unrest made supply from the Republic of South Africa an issue. Brazil moved toward greater production of ore and upgraded materials.

From a 1983 base, U.S. demand for manganese is expected to increase negligibly through 1990, as projected from a revised estimate of raw steel production trends. It is estimated that in 1986 domestic mine production of manganese ore 2/ will be zero, and U.S. apparent consumption of manganese will be 640,000 tons, content basis. The majority of total U.S. demand will be supplied by manganese imports in both ore and upgraded forms.

Manganese is an essential element for man and animals that can be harmful when in excess. Thus, manganese can be an industrial poison, but is not a hazard generally. The Environmental Protection Agency found as of August 1985 that ambient air concentrations of manganese posed no significant risk to public health, so that regulation directed specifically at manganese was unnecessary under the Clean Air Act.

9. World Mine Production and Reserve Base:

	Mine Production 1984	Mine Production 1985 e/	Reserve Base 7/
United States	-	-	-
Australia	1,874	2,100	480,000
Brazil	e/2,425	2,400	180,000
Gabon	2,336	2,300	440,000
India	e/1,433	1,400	70,000
Mexico	e/571	500	31,000
South Africa, Republic of	3,361	3,800	8,500,000
Other Market Economy Countries	e/366	400	42,000
China	e/1,760	1,800	110,000
U.S.S.R.	e/11,100	11,000	2,500,000
Other Centrally Planned Economies	e/116	115	25,000
World Total (rounded)	e/25,300	25,800	12,000,000

10. World Resources: Identified land-based resources are large but are irregularly distributed. The U.S.S.R. and the Republic of South Africa account for more than 80% of the world's identified resources; the Republic of South Africa for more than 75% of those of the market economy countries. Extensive accumulations of manganese as oxide nodules on ocean floors and as oxide crusts at shallower depths may have future commercial significance.

11. Substitutes: There is no satisfactory substitute for manganese in its major applications.

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MERCURY

(Data in 76-pound flasks of mercury content, unless noted)

1. Domestic Production and Use: The value of total domestic production, primary and secondary, was estimated at $6.6 million. One company produced mercury from its mine in Nevada and a small amount of mercury was recovered as a byproduct of gold refining. About five companies in the Eastern United States recovered secondary mercury from used instruments, batteries, dental amalgams, industrial scrap and/or residues. About 195 companies, universities, and Government facilities located east of the Mississippi River accounted for an estimated 94% of the Nation's mercury consumption. End use data in 1985 were estimated as follows: Electrical, 60%; electrolytic production of chlorine and caustic soda, 14%; paints, 10%; industrial and control instruments, 5%; and other, 11%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Mine (primary)	27,904	25,760	25,070	19,048	15,100
Secondary	1/ 11,244	4,473	13,751	5,217	6,000
Imports for consumption	12,408	8,916	12,786	25,327	20,000
Exports		Not available			
Shipments from Govt. stockpile excesses	-	7,076	6,000	4,092	3,300
Consumption: Reported	59,244	48,943	49,138	54,602	49,000
Apparent	57,286	44,737	55,416	57,960	49,200
Price, average value, dollars per flask: New York, dealer	413.89	370.93	322.44	314.38	315.00
London	417.52	376.96	313.33	306.40	295.00
Stocks, mine, consumer and dealer, yearend	27,339	28,827	31,018	26,742	22,000
Employment, mine and mill, average	48	45	45	41	35
Net import reliance 2/ as a percent of apparent consumption	44	32	30	58	57

3. Recycling: Production from old scrap totaled 6,000 flasks, equivalent to 12% of reported consumption.

4. Import Sources (1981-84): Spain 36%, Algeria 17%, Japan 13%, Turkey 8%, Other 26%.

5. Tariff: In 1985, mercury, and mercury-bearing waste and scrap imported from Turkey were duty free.

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Metal, waste and scrap	632.34	6.3¢/lb	6.4¢/lb	25¢/lb

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: In addition to the data shown below, 35,305 flasks of secondary mercury was held by the U.S. Department of Energy, Oak Ridge, TN.

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Mercury	10,500	170,539	-	4,499
Mercuric Oxide	-	80 lbs	-	350,875 lbs

e/ Estimated.
1/ Includes sales of surplus mercury from U.S. Department of Energy stocks.
2/ Defined as imports - exports + adjustments for Government and industry stock changes. Export data were not available and were assumed to be zero in the calculation.
3/ See page 182 for definitions.

Prepared by L. C. Carrico, telephone number (202) 634-1082.

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8. Events, Trends, and Issues: Domestic mine production in 1985 declined from that of 1984 as a result of increased imports over the past 2 years, sales of excess mercury and mercuric oxide from the National Defense Stockpile, and reduced consumer demand. The bulk of the mine production came from one mine in Nevada.

It is estimated that in 1986 domestic mine production of mercury will be 16,000 flasks and U.S. apparent consumption will be 49,000 flasks. From a 1983 base, demand for mercury is expected to decrease at an average annual rate of less than 1% through 1990.

The average monthly New York dealer price for primary mercury reached a low of $293.59 per flask in May, then increased through August to $323.00 per flask and remained at that level through October. Due to the static domestic mercury market the weekly New York dealer price remained at $323-$328 per flask for 15 consecutive weeks, commencing July 18. The average monthly London metal price reached a high of $301.66 per flask in January, declined in February to $300.12 per flask, and thereafter fluctuated below the $300.00 level through November.

During fiscal year 1985, the General Services Administration (GSA) sold 5,000 flasks of excess mercury authorized for sale from the National Defense Stockpile. GSA also terminated the mercuric oxide disposal program by selling the remaining excess quantity in the National Defense Stockpile at its September auction. From the inception of the mercuric oxide disposal program in 1981 through 1985, the following quantities were sold, in pounds: 1981--0; 1982--1,000; 1983--0; 1984--359,100; 1985--350,875; total--710,975. On October 15, GSA resumed its monthly auctions of surplus secondary mercury held by the U.S. Department of Energy in Oak Ridge, TN. GSA planned to dispose of 18,000 flasks during fiscal year 1986.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 3/
	1984	1985 e/	
United States	19,048	15,100	200,000
Algeria	10,000	23,000	100,000
Italy	-	-	2,000,000
Mexico	7,000	6,600	250,000
Spain	40,000	44,000	2,700,000
Turkey	4,210	5,300	200,000
Other Market Economy Countries	5,930	6,000	750,000
U.S.S.R.	64,000	64,000	500,000
Other Centrally Planned Economies	24,300	24,400	500,000
World Total (may be rounded)	174,488	188,000	7,200,000

10. World Resources: World mercury resources are estimated at 17 million flasks, located principally in Spain, the U.S.S.R., Yugoslavia, and Italy. At present production rates, sufficient resources are available for about 90 years.

11. Substitutes: Present and potential mercury substitutes include lithium, zinc air, or nickel-cadmium cells in batteries; diaphragm and membrane cells in the electrolytic production of chlorine and caustic soda; composite materials for dental fillings; and various compounds in exterior latex paint.

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MICA (NATURAL), SCRAP AND FLAKE 1/
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Scrap and flake mica production, excluding low-quality sericite, decreased about 13% in 1985. North Carolina accounted for 57% of U.S. production. The remaining output came from Connecticut, Georgia, New Mexico, Pennsylvania, South Carolina, South Dakota, and Texas. Scrap mica was recovered principally from mica and sericite schist and from feldspar, kaolin, and lithium beneficiation. The bulk of domestic production was processed into small particle-size mica by wet and dry grinding. Primary uses were joint cement, paint, roofing, oil well drilling, and rubber products. The value of 1985 scrap mica production was $6.0 million. Ground mica sales were valued at $19 million. There were 14 domestic producers of scrap and flake mica. Production of low-quality sericite, used primarily for brick manufacturing, totaled 33,000 tons, valued at $110,000.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production 2/ 3/, mine	133	106	140	161	140
ground	117	96	130	146	130
Imports for consumption e/	11	8	7	12	10
Exports e/	11	11	10	8	9
Consumption, apparent 4/	117	93	127	150	131
Price, average, dollars per ton, reported:					
Scrap and flake	62	61	46	44	44
Ground:					
Wet	349	419	397	392	400
Dry	119	136	118	123	125
Stocks, producer, yearend e/	7	7	7	7	7
Employment, mine e/	75	75	75	80	80
Net import reliance 5/ as a percent of apparent consumption	E	E	E	3	1

3. Recycling: None.

4. Import Sources (1981-84): Canada 63%, India 32%, Other 5%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Phlogopite, untrimmed	516.11	Free	Free	15.0% ad val.
Phlogopite, waste and scrap valued under 5¢/lb	516.21	4.4% ad val.	4.2% ad val.	25.0% ad val.
Other waste and scrap valued under 5¢/lb	516.24	2.4% ad val.	2.4% ad val.	25.0% ad val.
Other mica, unmanufactured	516.41	Free	Free	4¢/lb
Ground or pulverized	516.81	2.9% ad val.	2.4% ad val.	20.0% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. E Net exporter.
1/ See also Mica (Natural), Sheet.
2/ Sold or used by producing companies.
3/ Excludes low-quality sericite used primarily for brick manufacturing.
4/ Based on ground mica.
5/ Defined as imports - exports + adjustments for Government and industry stock changes.
6/ See page 182 for definitions.

Prepared by L. L. Davis, telephone number (202) 634-1184.

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8. Events, Trends, and Issues: The United States remained the major producer of scrap and flake mica, in 1985. Imported mica is used primarily for making mica paper and as a filler and reinforcer in plastics. It is estimated that in 1986 domestic mine production of scrap and flake mica will be 150,000 tons and U.S. apparent consumption of ground mica will be 145,000 tons. From a 1983 base, demand for scrap and flake mica is expected to increase at an average annual rate of about 1.0% through 1990.

   The principal environmental impact of mica mining was the land disturbance commonly associated with surface mining.

9. World Mine Production and Reserve Base:

	Production		Reserve Base 6/
	1984	1985 e/	
United States	161	140	Large
Brazil	2	2	Large
India	15	15	Large
Other Market Economy Countries	33	33	Moderate
Centrally Planned Economies	70	70	Large
World Total	281	260	Large

10. World Resources: Resources of scrap and flake mica are available in granite, pegmatite, schist, and clay deposits and are considered more than adequate to meet anticipated world demand in the foreseeable future.

11. Substitutes: Some of the lightweight aggregates such as diatomite, vermiculite, and perlite may be substituted for ground mica when used as a filler. Ground synthetic fluorophlogopite, a fluorine-rich mica, may replace natural ground mica for uses that require the thermal and electrical properties of mica.

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MICA (NATURAL), SHEET 1/
(Data in thousand pounds unless noted)

1. Domestic Production and Use: A minor amount of sheet mica, estimated at less than 500 pounds, was produced in North Carolina in 1985. The domestic consuming industry was dependent upon imports and shipments of Government stockpile excesses to meet demand. During 1985, an estimated 2.4 million pounds of sheet mica valued at $2.6 million was consumed primarily in the manufacture of electrical and electronic equipment.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, mine e/	2/	2/	2/	2/	2/
Imports for consumption	4,172	3,897	2,634	2,336	2,500
Exports e/	1,724	1,648	1,210	1,914	1,500
Shipments from Govt. stockpile excesses	995	844	256	1,711	1,500
Consumption, apparent	4,554	2,737	2,207	2,439	2,400
Price, average, dollars per pound, muscovite mica, reported:					
Block	9.34	15.50	13.06	13.57	13.60
Film	4.56	5.36	5.18	5.40	5.50
Splittings	0.61	0.69	0.60	0.71	0.70
Stocks, fabricator and trader, yearend e/	4,245	4,601	4,074	3,768	3,868
Employment, mine			None		
Net import reliance 3/ as a percent of apparent consumption	100	100	100	100	100

3. Recycling: None.

4. Import Sources (1981-84): India 75%, Belgium 10%, France 5%, Other 10%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Phlogopite, untrimmed	516.11	Free	Free	15% ad val.
Split block	516.31	Free	Free	Free
Other mica, unmanufactured	516.41	Free	Free	4¢/lb
Splittings	516.51	Free	Free	Free
Film not cut/stamped	516.61	Free	Free	Free
Film cut/stamped	516.71	4.4% ad val.	4.4% ad val.	45% ad val.
Block cut/stamped, not perforated, indented	516.73	5% ad val.	5% ad val.	40% ad val.
Block cut, other forms	516.74	8% ad val.	8% ad val.	40% ad val.
Block cut, perforated, indented	516.76	5% ad val.	5% ad val.	40% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimated.
1/ See also Mica (Natural), Scrap and Flake.
2/ Less than 1/2 unit.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ Exports and domestic consumption.
5/ See page 182 for definitions.

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7. Government Stockpile: The General Services Administration continued to dispose of excess splittings. In addition to the quantities shown below, the stockpile contains the following nonstockpile-grade material: 207,000 pounds, muscovite block, stained or better; 640 pounds, muscovite film, 1st and 2nd qualities; 114,000 pounds, phlogopite block; and 181,000 pounds of muscovite block, stained or lower.

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Block: Muscovite	6,200	5,006	-	-
Phlogopite	210	17	-	-
Film: Muscovite	90	1,176	1,032	3
Splittings: Muscovite	12,630	14,653	2/	753
Phlogopite	930	1,519	-	2/

8. Events, Trends, and Issues: The small quantity of sheet mica produced in the United States in the last several years was insignificant with respect to its demand. It is estimated that in 1986 domestic mine production of sheet mica will be negligible and U.S. apparent consumption will be 2 million pounds. Consumption has fluctuated considerably, but with a downward trend since 1960. The decline in demand has been caused by price increases, problems of obtaining quality supplies promptly, the increase in solid state technology, the availability of mica-based and nonmica-based substitutes, and imports of finished mica products from foreign sources. From a 1983 base, demand for sheet mica is expected to decline at an average annual rate of about 3% per year through 1990. There were no environmental problems associated with the manufacture of mica products.

9. World Mine Production and Reserve Base:

	Mine Production 1984	Mine Production 1985 e/	Reserve Base 5/
United States	2/	2/	Small
Brazil	300	300	Large
India	5/12,000	5/12,000	Very large
Madagascar	600	600	Large
Other Market Economy Countries	400	400	Moderate
Centrally Planned Economies	400	400	Large
World Total	13,700	13,700	Large

10. World Resources: There has been no formal evaluation of world resources of sheet mica because of the sporadic occurrence of this material. Large deposits of mica-bearing rock are known to exist in countries such as India, Brazil, and Madagascar. Limited resources of sheet mica are available in the United States. These domestic resources are uneconomic because of the high cost of hand labor required to mine and process the sheet mica.

11. Substitutes: There are many mica substitutes for sheet mica that have gained acceptance by the industry. These include built-up mica, reconstituted mica (mica paper), and glass-bonded and phosphate-bonded micas.

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MOLYBDENUM

(Data in thousand pounds of molybdenum content, unless noted)

1. Domestic Production and Use: In 1985, molybdenum valued at about $360 million (based on average oxide price) was produced by 11 firms. Three firms in California, Colorado, Idaho, and New Mexico mined molybdenum ore. Eight firms in Arizona, California, New Mexico and Utah recovered molybdenum as a byproduct or coproduct from copper, tungsten, and uranium ore. Four plants converted molybdenite (MoS_2) concentrate to molybdic oxide (MoO_3) from which intermediate products such as ferromolybdenum, metal powder, and various chemicals were produced. Iron and steel producers accounted for about 75% of the molybdenum consumed. Major end use applications were as follows: Machinery, 35%; oil and gas industry, 20%; transportation, 15%; chemicals, 15%; electrical, 10%; and other, 5%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, mine	139,900	84,381	33,593	103,664	107,000
Imports for consumption	7,900	10,037	8,924	8,434	9,000
Exports, all primary forms	58,171	56,842	52,385	75,891	78,000
Consumption: Reported	50,189	27,665	27,225	34,792	30,000
Apparent	56,000	31,000	39,000	41,000	31,000
Price, average value, dollars per pound of concentrate 1/	8.50	4.00	3.64	3.56	3.15
Stocks: Mine and mill concentrate, yearend	35,043	38,510	11,637	12,450	15,000
Other, producer and consumer, yearend	50,726	53,583	32,026	26,048	30,000
Employment, mine and mill, molybdenum production	5,500	1,500	2,500	3,600	2,300
Net import reliance 2/ as a percent of apparent consumption	E	E	3/ 7	E	E

3. Recycling: Some secondary molybdenum in the form of metal or superalloys was recovered, but the amount was small. An indeterminate quantity of molybdenum was reclaimed from spent catalysts. Although some molybdenum was recycled as a minor constituent of scrap alloy steels and iron, the use of such scrap did not generally depend on its molybdenum content.

4. Import Sources (1981-84): Chile 34%, Canada 21%, China 17%, Mexico 9%, Other 19%.

5. Tariff: In 1985, molybdenum concentrate imported from Chile and Mexico had a special tariff rate of 9.0¢/lb Mo content.

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Concentrate, molybdenum content	601.33	9.4¢/lb.	9.0¢/lb.	35¢/lb.
Ferromolybdenum, molybdenum content	606.31	4.9% ad val.	4.5% ad val.	31.5% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. E Net exports.
1/ Major producer price per pound of molybdenum contained in technical-grade molybdic oxide.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ Unusually large decreases in domestic stocks resulted in a positive net import reliance as a percent of apparent consumption.
4/ See page 182 for definitions.

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8. Events, Trends, and Issues: The 1985 molybdenum market reflected continuing over-supply conditions. The surplus conditions restrained the recovery of the market.

U.S. mine output of molybdenum in 1985 increased 3% when compared with that of 1984. Compared with that of 1984, apparent consumption declined about 25%, and exports of molybdenum increased by about 3%. U.S. producer inventories increased by 17% when compared with that of 1984.

From a 1983 base, demand for molybdenum is expected to increase at an average annual rate of about 0.8% through 1990. It is estimated that in 1986, domestic mine production of molybdenum will be 100 million pounds and U.S. apparent consumption will be 30 million pounds.

As a result of a soft market, the domestic price for technical-grade molybdic oxide averaged $3.15 per pound of contained molybdenum during 1985. Mine capacity utilization for 1985 was 40%.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 4/
	1984	1985 e/	
United States	103,664	107,000	11,800,000
Canada (shipments)	24,174	15,000	2,000,000
Chile	37,172	35,000	5,400,000
Mexico	4,740	9,000	500,000
Peru	6,800	10,000	500,000
Other Market Economy Countries	485	500	580,000
Centrally Planned Economies	31,630	33,000	5,170,000
World Total	208,665	209,500	25,950,000

10. World Resources: Identified resources amount to about 19 billion pounds of molybdenum in the United States and about 46 billion pounds in the world. Molybdenum occurs both as the principal metal sulfide in large low-grade porphyry molybdenum deposits and as a subsidiary metal sulfide in low-grade porphyry copper deposits. Resources of molybdenum are adequate to supply world needs for the foreseeable future.

11. Substitutes: There is little substitution for molybdenum in its major applications as an alloying element in steels, cast irons, and nonferrous metals. In fact, because of its availability and versatility, industry has sought to develop new materials which benefit from the alloying properties of molybdenum. Potential substitutes for molybdenum include chromium, vanadium, columbium, and boron in alloy steels; tungsten in tool steels; graphite, tungsten, and tantalum for refractory materials in high temperature electric furnaces; and chrome-orange, cadmium-red, and organic-orange pigments for molybdenum orange.

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NICKEL

(Data in short tons of nickel content, unless noted)

1. Domestic Production and Use: One company mined and smelted nickel ore in Oregon to produce ferronickel valued at $32 million. The operation was closed from mid-June until November to install a new ore concentrator and a slurry transportation system. One company refined nickel in Louisiana from imported matte. The company permanently closed the refinery during the fourth quarter owing to a shortage of feedstock. Two copper refineries produced byproduct nickel materials. Secondary nickel was recovered from stainless and alloy steel scrap, nickel-based alloy scrap, and copper smelter residues. One firm converted particulate wastes from stainless steel plants and spent catalysts into nickel-bearing pigs for making stainless steel. On a monthly or annual basis, 357 companies reported nickel consumption. Approximately 42% of the primary nickel consumed went into stainless and alloy steel production, 36% into nonferrous alloys, and 18% into electroplating. Ultimate end uses were: Transportation, 23%; chemical industry, 15%; electrical equipment, 12%; construction, 10%; fabricated metal products, 9%; petroleum, 8%; household appliances, 8%; machinery, 8%; and other, 7%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Mine	12,099	3,203	-	14,540	6,900
Plant, Refined metal:					
From domestic ore 1/	10,305	3,456	W	9,604	4,800
From foreign matte	38,500	41,500	33,400	35,329	30,000
Secondary	52,000	43,000	50,000	59,286	55,000
Imports for consumption	209,008	129,787	152,333	176,715	159,000
Exports, primary forms	19,674	37,356	23,359	27,927	28,000
Consumption: Reported, primary	144,851	103,981	127,845	136,861	123,000
Reported, secondary	43,768	35,690	42,034	49,649	46,000
Apparent 2/	206,000	181,000	201,000	218,000	185,000
Price (cathode), dollars per pound, New York dealer	2.65	2.24	2.20	2.22	2.28
Stocks: Consumer, yearend	22,508	18,853	20,448	20,934	21,000
Producer, yearend 3/	100,000	62,000	38,500	37,300	38,000
Employment: Mine e/	160	160	160	130	130
Smelter e/	230	230	230	170	170
Refinery e/	NA	420	420	420	420
Net import reliance 4/ as a percent of apparent consumption	75	76	5/75	68	68

3. Recycling: Of the 55,000 tons of nickel recovered from purchased scrap for consumption, 60% was estimated to be old scrap and 40% to be new.

4. Import Sources (1981-84): Canada 38%, Australia 14%, Botswana 12%, Norway 10%, Other 26%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Nickel ore and concentrates	601.36	Free	Free	Free
Nickel oxide	419.72	Free	Free	Free
Ferronickel	606.20	Free	Free	3¢/lb.
Unwrought nickel	620.03	Free	Free	3¢/lb.
Waste and scrap	620.04	Free	Free	3¢/lb.
Nickel flakes	620.30	1.9¢/lb.	Free	14¢/lb.
Nickel powders	620.32	Free	Free	3¢/lb.
Other, over 10% nickel	603.60	Free	Free	Free

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
1/ Includes byproduct nickel from primary copper operations.
2/ Defined as primary nickel produced in plants from domestic ores + scrap recovery + net import reliance.
3/ Stocks of producers, agents, and dealers held only in the United States.
4/ Defined as imports - exports + adjustments for Government and industry stock changes.
5/ Nickel production from domestic ore assumed to be zero for this calculation.
6/ See page 182 for definitions.

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7. Government Stockpile: In addition to the inventory shown below, an additional 352 tons of nickel purchased in September of 1984 has been delivered but not yet accepted into the stockpile pending completion of quality assurance tests.

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months	Purchases, 9 Months
Nickel	200,000	36,854	-	-	4,648

8. Events, Trends, and Issues: Domestic primary nickel consumption fell 10% as the U.S. economy slowed. Lower consumption in stainless steel and nickel-base alloys led the decline. Imports slowed accordingly while consumer stocks changed little from the 1984 amounts. From a 1983 base, demand for nickel is expected to increase at an average annual rate of about 2.5% through 1990. It is estimated that in 1986, domestic mine production of nickel will be 14,500 tons, and the U.S. apparent consumption will be about 218,000 tons. A continuing worldwide over-abundance of nickel production capacity kept nickel prices considerably below that required to prompt development of domestic deposits, which contain comparatively low concentrations of nickel.

9. World Mine Production and Reserve Base:

	Mine Production 1984	Mine Production 1985 e/	Reserve Base 6/
United States	14,540	6,900	2,800,000
Australia	82,900	81,000	5,300,000
Botswana	19,300	19,000	500,000
Brazil	12,100	12,000	4,700,000
Canada	192,000	195,000	14,800,000
Colombia	15,400	10,000	700,000
Dominican Republic	26,698	27,000	1,100,000
Finland	5,500	6,000	50,000
Greece	18,400	16,000	2,800,000
Indonesia	68,900	70,000	5,800,000
New Caledonia	45,200	44,000	17,000,000
Philippines	18,300	25,000	5,100,000
South Africa, Republic of	27,600	27,000	2,900,000
Zimbabwe	11,080	11,000	1,900,000
Other Market Economy Countries	3,922	4,000	8,700,000
Albania	6,600	6,600	200,000
China	15,400	16,000	1,000,000
Cuba	35,050	40,000	25,000,000
U.S.S.R.	192,000	197,000	8,100,000
Yugoslavia	4,400	3,000	1,800,000
Other Centrally Planned Economies	4,600	4,500	1,000,000
World Total (may be rounded)	819,890	821,000	111,000,000

10. World Resources: Identified world resources in deposits averaging approximately 1% nickel or greater contain 143 million tons of nickel. About 80% of the nickel is in laterites and 20% is in sulfide deposits. World resources of lower grade nickel deposits are very large. In addition, there are extensive deepsea resources of nickel in manganese nodules covering large areas of ocean floor, particularly in the Pacific Ocean.

11. Substitutes: With few exceptions, substitutes for nickel would result in increased cost or some sacrifice in the economy or performance of the product. Present and potential nickel substitutes include aluminum, coated steel, and plastics in the construction and transportation industries; nickel-free specialty steels in the power generating, petrochemical, and petroleum industries; titanium and plastics in severe corrosive applications; and platinum, cobalt, and copper in catalytic uses.

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NITROGEN (FIXED)--AMMONIA

(Data in thousand short tons of nitrogen, unless noted)

1. Domestic Production and Use: The total f.o.b. value of ammonia produced in the United States in 1985 was estimated to be $2.4 billion. Ammonia was produced by 59 plants owned by 46 firms, primarily by the steam reformation of natural gas. With few exceptions, ammonia manufacture is totally dependent on expensive fossil fuels. Approximately 80% of the ammonia produced was used as fertilizers that include anhydrous ammonia, urea, ammonium phosphate, ammonium nitrate, and other nitrogen compounds. Ammonia also was used to produce plastics, fibers, and resins, 10%; explosives, 4%; and numerous other chemicals, 6%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Ammonia					
Production	15,732	13,029	11,297	13,309	14,100
Imports for consumption	1,719	1,737	2,169	2,699	2,200
Exports	506	610	298	438	1,000
Consumption, apparent	16,467	14,145	13,719	15,287	15,400
Stocks, producer, yearend	1,960	1,970	1,422	1,705	1,600
Price, dollars per short ton, yearend, quoted f.o.b. gulf coast 1/	132	120	175	147	135
Employment, plant	4,000	3,000	3,000	3,200	3,200
Net import reliance 2/ as a percent of apparent consumption	5	8	18	13	8

3. Recycling: None.

4. Import Sources (1981-84): Ammonia: U.S.S.R 30%, Canada 28%, Trinidad & Tobago 20%, Mexico 19%, Other 3%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Ammonia, fertilizer	480.6540	Free	Free	Free
Ammonia, chemical	417.2200	3.3% ad val.	2.8% ad val.	28% ad val.

6. Depletion Allowance: Not applicable.

7. Government Stockpile: None.

e/ Estimated.
1/ Source: Green Markets.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 182 for definitions.

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8. Events, Trends, and Issues: Nitrogen fertilizer manufacture is the most capital and energy intensive branch of the chemical fertilizer industry. This fact has inhibited capital expansion and caused importation of ammonia from sources with low-cost natural gas feedstock. Several companies retrofitted their plants to increase energy efficiency. Also, a few U.S. companies arranged for construction of plants in countries with lower cost feedstock. Demand for ammonia was reduced, reflecting the 1983 payment-in-kind program to reduce crop production, but began to recover in 1984 and 1985. Export markets for U.S. ammonia also improved in 1984, and by midyear 1985 total tonnage exported had exceeded the 1984 total. U.S. farmers' debt continued to be a problem. Devalued land reduced collateral for financing farm loans. Some domestic producers were still hoping for protective legislation.

After a monthly high of $150 per ton in February, ammonia prices decreased. The low averaged about $135 per ton, f.o.b. gulf coast, compared with a monthly low of $143 in 1984. The highest monthly f.o.b. gulf coast ammonia price in 1984 had been about $200.

From a 1983 base, demand for ammonia is expected to increase at an average annual rate of about 2.2% through 1990. It is estimated that in 1986 domestic production of ammonia in terms of nitrogen content will be 14 million tons and U.S. apparent consumption will be 16 million tons.

9. World Production and Reserve Base:

	Plant Production		Reserve Base 3/
Ammonia	1984	1985 e/	
United States	13,309	14,100	Large
Canada	2,750	2,800	"
France	2,200	2,200	"
Germany, Federal Republic of	1,984	2,000	"
India	4,200	4,200	"
Italy	1,200	1,200	"
Japan	1,705	1,700	"
Mexico	1,954	2,000	"
Netherlands	2,486	2,500	"
United Kingdom	1,870	1,900	"
Other Market Economy Countries	15,287	15,500	"
Centrally Planned Economies	41,231	42,000	"
World Total	90,176	92,100	

10. World Resources: The availability of nitrogen from the atmosphere for fixed nitrogen production is unlimited. Hydrogen required for ammonia production is most commonly obtained from natural gas and by gasification of solid and liquid fuels. Natural gas is widely used to manufacture ammonia because of the comparable favorable costs with solid or liquid fuels. Natural nitrogen compounds occur in the Atacama Desert of Chile, where an estimated 2.5 billion tons of ore are above a cutoff of 7% sodium nitrate. The balance of the Atacama Desert resource may be as large as 25 billion tons.

11. Substitutes: Nitrogen is an essential fertilizer element which has no substitute. There are no economic substitutes for fixed nitrogen explosives and blasting agents in conventional uses. Specific substitutes are available for plastics, fibers, and synthetics but with changes in product characteristics.

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PEAT

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: The estimated value of U.S. production of peat for agricultural use in 1985 was about $21 million. Domestic production increased about 6%, imports decreased about 5%, and apparent demand increased about 15% compared with that of 1984. There were 84 producers with 100 active operations in 22 States. The five principal peat producing States, Florida, Michigan, Illinois, Indiana, and Pennsylvania, accounted for about 75% of U.S. production.

   The demand for packaged peat increased slightly. In 1985, packaged peat totaled about 55% of U.S. peat sales, and was used primarily for soil improvement and potting soil. Peat sold in bulk totaled 45% of U.S. peat sales and was used primarily for soil improvement, potting soils, nurseries, and golf courses.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production	686	798	704	800	850
Commercial sales	757	769	725	814	890
Imports for consumption	342	370	419	485	460
Exports			None		
Consumption, apparent	1,089	1,080	1,042	1,146	1,317
Price, average value, dollars per ton	24.82	21.94	25.73	24.47	24.52
Stocks, producer, yearend	269	357	438	577	570
Employment, mine and plant	770	700	670	700	725
Net import reliance 1/ as a percent of apparent consumption	37	26	32	30	35

3. Recycling: None.

4. Import Sources (1981-84): Canada, more than 99%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Peat moss, poultry-grade	192.5000	Free	Free	50¢ per long ton
Peat moss, fertilizer-grade	480.8060	Free	Free	Free

6. Depletion Allowance: 5% (Domestic).

7. Government Stockpile: None.

e/ Estimated.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ See page 182 for definitions.
3/ Including other centrally planned economies.

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8. Events, Trends, and Issues: The trend in industry was to find new uses for peat. Research into oxidatively solubilizing coal (OSC) in alcohol to produce a diesel-like fuel found that peat was also good feedstock for the process. Solutions of peat-derived OSC in methanol, containing as much as 50% by weight of the OSC, were similar to conventional diesel fuel in viscosity, lubricity, and cetane value. The combustion product was essentially smokefree and low in nitrogen oxides. The OSC derived from peat outperformed OSC made from some kinds of coal. However, the peat product was not marketable because of the abundance and relatively low price of oil.

Foreign countries with a domestic supply of peat have used it to generate heat and electricity for many years. In 1985, U.S. companies were trying to develop peat-fired power generators. A peat company in Maine secured private financing to construct a peat-fired electric powerplant. Another company in North Carolina considered building a power generating plant. Each of these projects would be located at the peat bog, thereby eliminating the high cost of transporting peat over long distances to the plant.

Mat, a new peat product for horticultural use produced by a Minnesota firm, was made of about 10% textile fibers, 45% wood fibers, and 45% peat. It was produced in rolls 5 feet wide and 20 to 30 feet long. Mat, innoculated with seeds, is used to promote lawn and vegetable growth.

From a 1983 base, demand for peat is expected to increase at an average annual rate of about 3.4% through 1990. It is estimated that in 1986 domestic production of peat will be 875,000 tons and U.S. apparent consumption will be 1.3 million tons.

9. World Mine Production and Reserve Base:

	Production		Reserve Base 2/
	1984	1985 e/	
United States	800	850	7,000,000
Canada	550	555	10,000,000
Finland	4,850	4,900	7,000,000
Germany, Federal Republic of	2,591	2,600	500,000
Ireland	5,947	6,000	200,000
Other Market Economy Countries	1,034	1,050	5,000,000
U.S.S.R.	397,000	397,000	3/20,000,000
Other Centrally Planned Economies	297	300	-
World Total (may be rounded)	413,069	413,000	50,000,000

10. World Resources: World resources of peat are estimated at 2.1 trillion tons, of which the U.S.S.R. has about 850 billion short tons and Canada about 560 billion short tons. Domestic deposits of peat occur in all 50 States, with estimated resources of about 340 billion tons, or about 16% of the world total.

11. Substitutes: Straw, tree bark, and other fibrous plant materials can be used as a mulch, and, in some instances, substituted for peat as a soil additive in agriculture. The superior water-holding capacity of peat limits this substitution.

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PERLITE

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: The estimated value, f.o.b. mine, of processed perlite produced in 1985 was $17.5 million. Crude ore production came from 12 mines operated by 10 companies in 6 Western States. The leading five companies supplied 92% of production. New Mexico, with 87% of the U.S. crude ore mined, continued to be the major producing State. Processed ore was expanded at 65 plants in 32 States. The principal end uses were building construction products, 67%, and filter aid, 15%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, mine 1/	591	506	474	498	512
Imports for consumption	-	16	36	45	50
Exports e/	-	20	17	20	22
Consumption, apparent	591	502	493	523	540
Price, average value, dollars per ton, f.o.b. mine	29.47	31.71	33.05	33.41	34.00
Stocks, producer, yearend	Not available				
Employment: Mine and mill	160	150	150	150	150
Net import reliance 2/ as a percent of apparent consumption	E	E	4	5	5

3. Recycling: None.

4. Import Sources (1981-84): Greece, 100%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Crude mineral substances, not specifically provided for	523.81	Free	Free	Free

6. Depletion Allowance: 10% (Domestic), 10% (Foreign).

7. Government Stockpile: None.

e/ Estimated. E Net exporter.
1/ Processed perlite sold and used by producers.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 182 for definitions.

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8. Events, Trends, and Issues: From a 1983 base, demand for perlite is expected to increase at an average annual rate of about 3% through 1990. The supply of perlite from domestic reserves is expected to adequately meet requirements. It is estimated that in 1986 domestic production of processed perlite will be 520,000 tons and apparent consumption will be 550,000 tons.

   Perlite mining has the normal problems of disposal of overburden and the ultimate condition of the abandoned pit sites, but overall it results in a relatively small area of disturbed surface. Mining generally occurred in remote areas and environmental problems were not severe.

9. World Processed Perlite Production and Crude Ore Reserve Base:

	Production		Reserve Base 3/
	1984	1985 e/	
United States	498	512	200,000
Greece	154	160	300,000
Other Market Economy Countries	243	240	500,000
Centrally Planned Economies	554	550	1,000,000
World Total (may be rounded)	1,449	1,460	2,000,000

10. World Resources: Very little information is available in perlite-producing countries to estimate resources with any reliability.

11. Substitutes: Alternate materials can be substituted for all uses of perlite, if necessary. Long-established competitive commodities include vermiculite, pumice, slag, diatomite, and expanded clay and shale.

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PHOSPHATE ROCK

(Data in thousand metric tons, unless noted)

1. Domestic Production and Use: Marketable phosphate rock was produced by 20 companies, and the estimated value was $1.2 billion. Twelve companies in Florida and one in North Carolina produced 86% of the phosphate rock. Companies producing phosphate rock in Idaho, Utah, and Montana reported 11% of the total production. Production in Tennessee was about 3% of the total. The principal domestic markets for phosphate rock were fertilizer, 91%; and chemicals manufactured from either elemental phosphorus or refined wet process phosphoric acid, 9%. About 22% of the phosphate rock produced was exported and about 50% was processed into chemicals and fertilizer for export. The major byproducts were fluosilicic acid, vanadium, and uranium.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, marketable	53,624	37,414	42,573	49,197	51,000
Sold or used by producers	45,526	38,571	46,839	53,277	48,000
Imports for consumption	13	31	9	9	10
Exports	10,395	9,842	12,010	11,528	11,000
Consumption 1/	35,144	28,760	34,838	41,758	37,010
Price, average value, dollars per ton, f.o.b. mine 2/	26.63	25.50	23.97	23.99	23.50
Stocks, producer, yearend	19,619	18,287	14,500	11,897	14,000
Employment, mine and beneficiation plant	10,000	8,000	7,500	6,500	5,500
Net import reliance 3/ as a percent of apparent consumption	Net exporter				

3. Recycling: None.

4. Import Sources (1981-84): Mexico 60%, Netherlands Antilles 40%.

5. Tariff:

Item	Number	Most Favored Nation 1/1/86	Most Favored Nation 1/1/87	Non-MFN 1/1/86
Phosphates, crude and apatite	480.4500	Free	Free	Free

6. Depletion Allowance: 14% (Domestic) 14% (Foreign).

7. Government Stockpile: None.

8. Events, Trends, and Issues: U.S. agribusiness was at lowered levels as a result of the 1983 payment-in-kind program. Although farm prices showed temporary relief, agribusiness declined. Export markets for U.S. farm products declined in 1984 from increased foreign, competition and from increased productivity from other areas in the world. U.S. farmers debt load increased in 1983 and farm land prices, the collateral for financing seed, fertilizer, and machinery, declined. From a 1983 base, demand for phosphate rock is expected to increase at an average annual rate of about 1.8% through 1990. It is estimated that in 1986, domestic production of marketable phosphate rock will be 52 million tons and U.S. consumption will be 38 million tons. Production and consumption could be considerably less than forecast by changing production plans and long range demand growth rates if agribusiness profit margins do not improve. The U.S. phosphate industry has become increasingly dependent on export markets, shipping about 82% of phosphate rock production in 1984 as phosphate rock, processed phosphates, and phosphate uptake in principal crops into foreign markets.

e/ Estimated.
1/ Defined as sold or used plus imports minus exports.
2/ Marketable phosphate rock, weighted value, all grades, domestic and exports.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.

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As 1985 progressed, the U.S. and world phosphate rock industry functioned to produce phosphate fertilizers and created an oversupply that, coupled with rising sulfur prices, reduced or eliminated profit margins on processed phosphates. Unusually low prices established by a competitive international market induced buyers to restock supplies of phosphate fertilizers at prices frequently below production costs. By mid-1985, most eastern U.S. producers temporarily closed or reduced production from mines and plants to reduce financial losses and adjust inventories.

There is an element of uncertainty over the effects of the Government's farm product export subsidy program designed to improve the competitive position of U.S. exporters with subsidized European exporters. The success or failure of the program will change phosphate rock demand. New or replacement phosphate rock mines would not be profitable at today's production economics and low selling prices for downstream products. Further restrictions on sodium tripolyphosphate, the detergent builder, are expected to reduce the demand for thermal phosphorus. As phosphate rock mines and fertilizer plants in other areas of the world become operational, U.S. grain selling companies may find it advantageous to backhaul these commodities for sale and distribution in the United States or to achieve U.S. grain sales, barter for foreign-produced fertilizer.

As mines are depleted or closed for economic reasons in Florida, increased emphasis is being placed on finding a replacement tax base for the mining industry and reclaiming mined out lands. The most promising program appears to be reclamation for produce farming to profitably supply the anticipated surge in population in cities on the Gulf of Mexico.

9. World Mine Production and Reserve Base:

	Production		Reserve Base *
	1984	1985 e/	
United States	49,197	51,000	5,400,000
Israel	3,312	3,500	90,000
Jordan	6,263	7,000	510,000
Morocco	21,245	23,000	20,000,000
Senegal	1,912	2,000	130,000
South Africa, Republic of	2,585	2,700	2,600,000
Togo	2,696	2,700	50,000
Tunisia	5,346	6,000	120,000
Other Market Economy Countries	13,615	14,000	2,970,000
China	11,800	13,000	210,000
U.S.S.R.	31,900	33,000	1,300,000
Other Centrally Planned Economies	700	700	325,000
World Total (may be rounded)	150,571	159,000	34,000,000

10. World Resources: Most of the U.S. and world phosphate rock resources are widely distributed marine phosphorite deposits. Identified and undiscovered resources are estimated to contain billions of tons of contained phosphorus. Identified resources in North and West Africa and in the Middle East are estimated to be several times greater than present reserves. Large phosphate resources have been identified on the continental shelves and on sea mounts in the Atlantic and Pacific Oceans. Work is continuing to identify additional resources in these areas. Phosphate rock contains fluorine as an integral part of the mineral apatite. Uranium and vanadium are present in marine phosphorite deposits and rare earths are present in igneous apatite deposits in quantities that may be profitably recoverable.

11. Substitutes: There are no substitutes for phosphorus in agriculture.

* The criteria for the reserve base were established by a joint Bureau of Mines and U.S. Geological Survey working group. The criteria for classification of phosphate resources are given in Geological Survey Circular 882, Sedimentary Phosphate Resource Classification System of the U.S. Bureau of Mines and the U.S. Geological Survey.

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PLATINUM-GROUP METALS

(Platinum, palladium, iridium, osmium, rhodium, ruthenium)
(Data in thousand troy ounces, unless noted)

1. Domestic Production and Use: Domestic primary refined production was derived entirely as a byproduct of copper refining by three firms, located in New Jersey, Utah and Texas, and was valued at about $2.6 million. Secondary metal was refined by about 20 firms, mostly on the east and west coasts. Platinum-group metals (PGM) were sold by at least 90 processors and retailers, largely in the Northeast, and were distributed among using industries as follows: Automotive, 40%; electrical and electronic, 25%; dental and medical, 15%; chemical, 10%; and other, 10%. The automotive, chemical, and petroleum refining industries used PGM mainly as catalysts. The other industries used PGM in a variety of ways that took advantage of their chemical inertness and refractory properties.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Mine	7	8	6	15	10
Primary refined	7	9	9	24	10
Secondary:					
Nontoll-refined	392	344	303	339	250
Toll-refined	1,191	868	995	1,157	1,200
Imports for consumption:					
Refined	2,611	2,150	2,790	3,928	3,300
Total	2,850	2,494	3,218	4,474	4,100
Exports:					
Refined	651	439	446	597	660
Total	863	836	1,229	1,162	1,100
Consumption: Reported, sales to industry	1,921	1,873	1,914	2,469	2,500
Apparent 1/	2,414	1,871	2,810	3,322	3,195
Price, dealer, average, dollars per ounce:					
Platinum	446	327	424	357	270
Palladium	95	67	136	148	114
Stocks, yearend:					
Government 2/	1,725	1,729	1,735	1,744	1,747
Industry	918	1,107	943	1,297	1,000
Shipments from Govt. stockpile excesses 3/	-	(7)	(4)	(9)	(2)
Employment, refinery e/	400	400	400	400	400
Net import reliance 4/ as a percent of apparent consumption	83	81	89	89	92

3. Recycling: About 250,000 ounces of PGM were refined from scrap on a nontoll basis. The quantity of toll-refined secondary was much larger, amounting to about 1.2 million ounces. The proportion of new scrap to old scrap was not known.

4. Import Sources (1981-84): Republic of South Africa 45%, United Kingdom 16%, U.S.S.R. 13%, Other 26%.

5. Tariff:

	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Ore	601.39	Free	Free	Free
Metals	605.02, 605.07	Free	Free	Free
Alloys	605.03, 605.08	9.7% ad val.	8.2% ad val.	65%.0% ad val.
Scrap	605.70	Free	Free	Free

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimated.
1/ Domestic mine production plus nontoll scrap production plus net import reliance (see footnote 4).
2/ Includes platinum, palladium, and iridium. The 1985 figure includes 9,600 ounces of palladium and 1,800 ounces of iridium purchased but not added to inventory.
3/ Figures in parentheses denote purchases.
4/ Defined as refined imports - refined exports + adjustments for Government and industry stock changes.
5/ See page 182 for definitions.

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7. Government Stockpile: In January 1985, the General Services Administration (GSA) purchased 2,400 ounces of grade B (99.8% minimum) palladium sponge for the National Defense Stockpile.

Stockpile Status-9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales 9 Months	Purchases 9 Months
Platinum	1,310	440	-	-	-
Palladium	3,000	1,262	-	-	2
Iridium	98	30	-	-	-

In addition to quantities shown above, the stockpile contains 13,043 ounces of nonstockpile-grade platinum and 2,214 ounces palladium.

8. Events, Trends, and Issues: World production of PGM increased about 4% in 1985, largely due to a 10% increase in production from the Republic of South Africa. Sales of PGM to U.S. industries increased slightly to about 2.5 million ounces, with the largest end use remaining automobile catalytic converters. It is estimated that in 1986 domestic mine production of PGM will be 10,000 ounces and that U.S. apparent consumption will be 3.3 million ounces. From a 1983 base, demand for PGM is expected to increase at an average annual rate of about 2.5% through 1990.

One of the three partners developing a palladium mine at the Stillwater Complex in Montana sold its one-third partnership interest to a Canadian company for $15 million. A contract was awarded to another company to conduct underground test mining at Stillwater. The current plan is to begin, by 1987, to process 500 tons of ore per day, yielding 75,000 ounces of palladium and 25,000 ounces of platinum per year, rates which would be increased later.

A major producer of precious metals began construction of a custom catalyst plant near Seneca, S.C. The new $25 million plant will replace the company's Newark, N.J. plant. The catalysts produced will be based on palladium, platinum, rhodium and ruthenium.

The European Economic Community (EEC) agreed to introduce restrictions on automobile emissions, to be implemented in stages between 1988 and 1993. Currently, the only way to meet the EEC standard, roughly equivalent to the current U.S. standard, is by using automobile catalytic converters. The EEC standard is expected to have a major impact on world demand for platinum and rhodium, and a lesser impact on demand for palladium, over the next decade.

There were no significant environmental problems involved with refining PGM.

9. World Mine Production and Reserve Base:

	Mine Production 1984	Mine Production 1985 e/	Reserve Base 5/
United States	15	10	16,000
Canada	348	350	9,000
South Africa, Republic of	2,900	3,200	970,000
Other Market Economy Countries	90	90	-
U.S.S.R.	3,700	3,700	200,000
World Total (rounded)	7,100	7,400	1,200,000

10. World Resources: World resources of PGM are estimated to be 3.3 billion ounces. U.S. resources are estimated at 300 million ounces.

11. Substitutes: According to a study completed in 1985 by the Office of Technology Assessment, the possibility of substituting other materials for PGM are greatest for electronic applications, and least for catalytic applications. In electrical contacts, gold can substitute for palladium-nickel, but at a higher cost. In dental crowns, gold and silver can substitute for palladium, although the trend has been to use more palladium and less gold and silver. Titanium is being explored for use in dental crowns in the United States and is currently being used in Japan and Switzerland.

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POTASH

(Data in thousand metric tons of K_2O equivalent, unless noted)

1. Domestic Production and Use: The value of U.S. production of marketable potash, f.o.b. mine, in 1985 was about $185 million. Potash production was centered in southeastern New Mexico, where five companies, operating five mines by conventional mining of bedded deposits, produced 87% of the U.S. total. One of these mines was closed for an indefinite period in October after operating at 61% of its 1984 capacity. Another mine reduced its capacity to 50% of its 1984 level after being sold at the end of March; the other three mines operated above 75% capacity for the year. One company in Utah recovered potash by solution mining underground, solar evaporation, and flotation, while another collected subsurface brines for solar evaporation and flotation. One company in California recovered potash and coproduct boron compounds and salt cake from subsurface brines using various crystallization techniques. About 95% of U.S. potash sales was used directly in the fertilizer industry and about 5% was used in the chemical industry. Most potash was produced as potassium chloride (muriate of potash). Potassium sulfate and potassium magnesium sulfate, produced for special crops and soils, comprised about one-sixth of the potash production. Potash was distributed by train, truck, and barge to warehouses, wholesalers, and retailers; some potash was sold from barges being used as temporary warehouses. Retailers sold both potash and potash blended with other fertilizers in dry or liquid forms for distribution over the fields in both spring and fall.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, marketable	2,156	1,784	1,429	1,564	1,325
Imports for consumption	4,796	3,858	4,440	4,829	4,825
Exports	491	519	300	446	350
Consumption, apparent	6,213	5,123	5,653	6,022	5,782
Price, dollars per metric ton of K_2O, average, muriate, f.o.b. mine 1/	137	109	100	109	95
Stocks, producer, yearend	520	520	2/391	3/312	330
Employment: Mine	1,830	1,620	1,220	1,110	865
Mill	1,400	1,140	930	682	570
Net import reliance 4/ as a percent of apparent consumption	65	65	75	74	77

3. Recycling: None.

4. Import Sources (1981-84): Canada, 90%; Israel, 6%; German Democratic Republic, 1%; U.S.S.R., 1%; Other, 2%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Potassium chloride	480.50	Free	Free	Free
Potassium sulfate	480.55	Free	Free	Free
Potassic fertilizers and fertilizer materials	480.75	Free	Free	Free

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated.
1/ Average prices based on actual sales, excluding soluble and chemical muriates.
2/ Inventory adjustment of 46,000 tons.
3/ Inventory adjustment of 4,000 tons.
4/ Defined as imports - exports + adjustments for Government and industry stock changes.
5/ See page 182 for definitions.
6/ Total reserve base in the Dead Sea is equally divided between Israel and Jordan.

Prepared by J. P. Searls, telephone number (202) 634-1190.

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8. Events, Trends, and Issues: Demand for potash in the United States decreased about 4% in 1985 compared with that of 1984. Production in 1985 decreased about 15% compared with that of 1984. Large stockpiles of North American-produced potash kept potash prices low for the entire year, while another good domestic grain harvest combined with lower than expected U.S. grain exports further depressed the domestic agricultural demand for potash in the fall. Around the world, several former markets for imported foodstuffs have developed self-sufficiency in grain production. This could mean weak future markets for U.S. crops. Interest rates to the farmer remained relatively high, and falling farm profits and the ensuing falling farm real estate prices have put some farmers in danger of loan default. The price of muriate of potash fell about 13% from the 1984 level and appeared to be below the long-term cost of production for most U.S. potash producers. The geographic area to which the domestic producers could sell at prices lower than all competitors seemed to be decreasing as competing mines accepted less profit or larger losses. This reduced the total domestic production capacity that could be supported by market demand. A New Mexico mine closed indefinitely in October and another mine was sold in March with the immediate reduction of its capacity by one-half. Two Carlsbad, NM, mines remained for sale. A Utah producer from subsurface brines returned to production. The Utah producer that had been flooded by the Great Salt Lake did not return to production.

Imports of potash showed no change from those of the previous year, but exports declined about 22%. The U.S. dollar remained relatively expensive in world money markets, restraining U.S. exports of potash even though the market was typically quoted in U.S. dollars. Barter deals were prevalent in international trading.

The antidumping petitions filed by domestic producers in 1984 did not cause a permanent change in the pattern of U.S. imports of potash. No permanent tariff was imposed on any foreign source, although the reasons for nonimposition of countervailing duties (domestic tariffs to counteract foreign subsidies to the foreign producers) against the German Democratic Republic and the U.S.S.R. were successfully challenged before the U.S. Court of International Trade. The U.S. Department of Commerce appealed the opinion and order.

It is estimated that in 1986, domestic mine production of potash will be 1.0 million tons and U.S. apparent consumption will be 5.6 million tons. From a 1983 base, demand for potash is expected to increase at an average annual rate of about 1.8% through 1990.

9. World Mine Production and Reserve Base:

	Production		Reserve Base 5/
	1984	1985 e/	
United States	1,564	1,325	360,000
Canada (sales)	7,685	7,500	9,700,000
France	1,500	1,500	50,000
Germany, Federal Republic of	2,280	2,280	600,000
Israel	1,100	1,200	6/ 600,000
Italy	180	200	40,000
Jordan	280	400	6/ 600,000
Spain	677	650	50,000
United Kingdom	360	400	30,000
Other Market Economy Countries	22	20	450,000
Developing Countries	-	-	120,000
German Democratic Republic	3,450	3,450	1,000,000
U.S.S.R.	9,500	9,600	3,800,000
Other Centrally Planned Economies	40	80	20,000
World Total (may be rounded)	28,638	28,600	17,000,000

10. World Resources: Estimated domestic potash resources total about 6 billion tons. Most of this lies between 6,000 and 10,000 feet deep, in a 1,200-square-mile area of Montana/North Dakota as an extension of the Williston Basin deposits in Saskatchewan. The Paradox Basin in Utah contains approximately 2 billion tons, mostly at depths of more than 4,000 feet. An unknown quantity of potash resources lies about 7,000 feet under central Michigan. Estimated world resources total about 250 billion tons. The potash deposits in the U.S.S.R. account for most of the Centrally Planned Economy countries' resources. Very large resources, about 10 billion tons and mostly carnallite, occur in Thailand.

11. Substitutes: There are no substitutes for potash as an essential plant nutrient.

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PUMICE AND PUMICITE

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: The estimated value of pumice and pumicite sold or used in 1985 was $5.1 million. Domestic output came from 21 producers in 8 States. The principal producing States were California, Idaho, New Mexico, and Oregon; their combined production accounted for about 95% of the national total. California led all producing States with eight active operations. The major uses of pumice and pumicite were in concrete aggregate and building block, about 88% of apparent consumption.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, mine 1/	499	416	449	502	556
Imports for consumption	92	121	184	293	275
Exports e/	1	1	1	1	1
Consumption, apparent	590	536	632	794	830
Price, average value, dollars per ton, f.o.b. mine or mill	8.64	9.01	9.99	9.82	9.00
Stocks, yearend		Not available			
Employment, mine and mill	60	60	60	60	60
Net import reliance 2/ as a percent of apparent consumption	15	22	29	37	33

3. Recycling: None.

4. Import Sources (1981-84): Greece 96%, Other 4%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Used in the manufacture of masonry products such as building blocks, bricks, tiles, and similar forms	519.05	Free	Free	Free
Crude or crushed:				
Valued not over $15 per ton	519.11	0.01¢/lb	0.01¢/lb	0.1¢/lb
Valued over $15 per ton	519.14	0.035¢/lb	0.035¢/lb	0.25¢/lb
In grains or ground, pulverized or refined	519.31	0.13¢/lb	0.13¢/lb	0.75¢/lb
Millstones, abrasive wheels, and abrasive articles, n.s.p.f.	519.93	5.0% ad val.	4.7% ad val.	35% ad val.
Articles, n.s.p.f.	523.61	3.3% ad val.	2.8% ad val.	35% ad val.

6. Depletion Allowance: 5% (Domestic), 5% (Foreign).

7. Government Stockpile: None.

e/ Estimated. NA Not available. N.s.p.f. Not specifically provided for.
1/ Quantity sold or used by producers.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 182 for definitions.
4/ Excluding Centrally Planned Economies.

Prepared by A. C. Meisinger, telephone number (202) 634-1185.

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8. Events, Trends, and Issues: From a 1983 base, demand for pumice and pumicite is expected to increase at an average annual rate of about 2% through 1990. Domestic reserves of pumice are expected to adequately supply domestic demand. Changing geographic demand patterns coupled with increasing transportation costs and lack of detailed reserve information could create problems for selecting new production locations. It is estimated that in 1986 domestic mine production of pumice and pumicite will be 570,000 tons and U.S. apparent consumption will be 850,000 tons.

   All domestic mining of pumice in 1985 was by open pit methods and generally occurred in relatively remote areas where land use conflicts were not severe. Although the generation and disposal of reject fines in mining and milling resulted in a dust problem at some operations, the environmental impact was restricted to a small geographical area.

9. World Mine Production and Reserve Base:

	Production		Reserve Base 3/
	1984	1985 e/	
United States	502	556	Large
France	660	650	NA
Germany, Federal Republic of	290	300	NA
Greece	2,370	2,400	NA
Italy	6,820	6,800	NA
Other Market Economy Countries	2,750	2,800	NA
Centrally Planned Economies	NA	NA	NA
World Total 4/ (rounded)	13,400	13,500	NA

10. World Resources: The domestic identified resources of pumice and pumicite in the West are estimated to be at least 25 million tons. The estimated resources in the Western and Great Plains States are 250 million to 450 million tons.

11. Substitutes: Transportation cost determines the maximum distance that pumice and pumicite can be shipped and remain competitive with alternate materials. Alternate competitive materials that can be substituted for pumice and pumicite for several end uses include expanded shale and clay, diatomite, and crushed aggregates.

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QUARTZ CRYSTAL, INDUSTRIAL
(Data in thousand pounds, unless noted)

1. Domestic Production and Use: There was no reported U.S. production of natural quartz suitable for direct electronic or optical applications. However, lascas 1/ was mined by two companies in Arkansas. In addition, seven operations used lascas to manufacture cultured quartz crystal. Estimated lascas production in 1985 decreased sharply and had a value of about $630,000. Quartz crystal was essential for making piezoelectric filter devices that separate desired from undesired portions of the frequency spectrum and oscillators that provided single frequency signal sources. Filters and oscillators were used for a wide variety of communications and instrumentation purposes.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Mine e/2/	175	200	600	2,500	1,000
Plant, cultured (as-grown)	660	478	426	1,027	300
Imports for consumption:					
Lascas	389	417	153	569	300
Natural electronic 3/	4/	4/	4/	4/	4/
Cultured	Not available				
Exports:					
Lascas	NA	NA	339	e/1,600	800
Natural electronic 3/	127	69	28	42	99
Cultured (mostly lumbered) 3/	125	115	80	277	160
Shipments from Govt. stockpile excesses, natural electronic	311	16	4	127	85
Consumption, reported:					
Lascas 5/	852	533	677	1,300	300
Natural electronic	14	16	13	7	10
Cultured 6/	609	482	424	306	250
Consumption, apparent:					
Lascas	NA	NA	673	1,057	658
Natural electronic	Not available				
Cultured	Not available				
Price, average value, dollars per pound:					
Lascas	0.50 to 3.60				
Cultured	20 to 550				
Stocks, industry, yearend:					
Lascas (for cultured crystal only)	1,026	1,005	746	1,158	1,000
Natural electronic (fabricator)	61	48	37	23	25
Cultured (fabricator)	64	74	53	134	100
Employment, mine, processing plant e/	11	18	21	75	12
Net import reliance 7/ as a percent of apparent consumption:					
Lascas	NA	NA	11	E	E
Natural electronic	Not available				
Cultured	Not available				

3. Recycling: None.

4. Import Sources (1981-84): Brazil 100%.

e/ Estimated. NA Not available. E Net Exporter.
1/ Lascas is natural nonelectronic-grade quartz used as feedstock for growing cultured quartz crystal and for production of fused quartz.
2/ Lascas only; specimen and jewelry material excluded.
3/ Quantities calculated from pricing information.
4/ Less than 1/2 unit.
5/ Excluding quartz crystal used by the fused quartz industry.
6/ Reported consumption of cultured includes cultured quartz crystal consumed by growers as well as by manufacturers of intermediate products and finished crystal units.
7/ Defined as imports - exports + adjustments for Government and industry stock changes.
8/ See page 182 for definitions.

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5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Brazilian Pebble, Crude	521.21	Free	Free	Free

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: The General Services Administration offered a limited amount of the excess stockpile-grade quartz crystal for sale. All 957 pounds of nonstockpile-grade quartz crystal contained in the stockpile were sold during the year.

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Quartz crystal	600	1,848	84	84

8. Events, Trends, and Issues: Japan became the world leader in the production of cultured quartz crystal and the United States dropped to the number two position. The United States depended on small quantities of Brazilian natural quartz needed as seed material for growing cultured quartz and for a few direct applications such as deep well pressure transducers.

Although worldwide estimates for lascas and cultured quartz crystal demand increased slightly from their record setting levels of 1984, the U.S. quartz crystal industry suffered an overall decline in 1985 with lower production, exports, and domestic consumption. By yearend, most operations had experienced layoffs and some prices had been lowered slightly to compete in foreign markets. While a number of factors were given as reasons for the downturn, including double ordering of quartz crystal during the previous year's boom when there was a shortage of quartz crystal, the relative strength of the U.S. dollar compared with some foreign currencies, and the decline from projected sales forecasts for personal computers that contain quartz resonators, the major factor was the doubling of autoclave capacity by the five largest Japanese quartz growing companies. With the increased capacity, the Japanese companies were no longer as dependent on imports of cultured quartz from the United States.

U.S. lascas production dropped, owing to the decline in lascas demand by the U.S. quartz crystal industry and increased lascas competition from Madagascar, which benefited from its closer proximity to Japan. Demand for U.S. lascas for use as feedstock by the fused quartz industry also declined, but not to the extent that was experienced by the cultured quartz industry. It is estimated that in 1986 domestic production of lascas will be 1.5 million pounds and U.S. apparent consumption will be 800,000 pounds. From a 1983 base, demand for lascas by the cultured quartz industry is expected to increase at an average annual rate of about 13.1% through 1990.

9. World Mine Production and Reserve Base:

	Production 1984	Production 1985	Reserve Base 8/
United States e/2/	2,500	1,000	Small
Brazil	NA	NA	Large
Other Market Economy Countries	NA	NA	NA
Centrally Planned Economies	NA	NA	NA
World Total	NA	NA	NA

10. World Resources: Limited resources of natural quartz crystal, suitable for direct electronic or optical use, are available throughout the world. World dependence on these resources will continue to decline because of increasing acceptance of cultured quartz crystal as an alternate material; however, this will mean an increased dependence on lascas for growing cultured quartz.

11. Substitutes: Quartz crystal is the best material for frequency-control oscillators. Other materials, such as dipotassium tartrate, are usable only in specific applications as oscillators and frequency filters.

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RARE-EARTH METALS 1/

(Data in metric tons of rare-earth oxide (REO) content, unless noted)

1. Domestic Production and Use: In 1985, two companies mined rare-earth ore minerals in the United States. Bastnasite was mined in California by surface methods and accounted for most of domestic rare-earth production. Monazite was mined in Florida by placer methods and was a byproduct of processing heavy minerals sands for titanium and zirconium minerals. Thorium and yttrium were byproducts of the separation of lanthanides from monazite. The United States was the world's principal producer and processor of the rare earths and was a major exporter and consumer of rare-earth products. Rare-earth ores and compounds were processed mainly by four companies with plants in Arizona, Texas, Tennessee, California, Colorado, and Pennsylvania. Industrial consumption was estimated as follows: Petroleum catalysts, 59%; metallurgical uses (including pyrophoric alloys), 23%; ceramic and glass, 15%; and other uses (electrical, phosphors, permanent magnets, laser crystals, research, and miscellaneous), 3%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Bastnasite concentrates	17,082	17,501	17,083	25,311	22,000
Monazite concentrates	W	W	W	W	W
Imports for consumption: e/					
Monazite	4,108	3,962	2,215	3,114	3,500
Metals, alloys, oxides, and compounds	1,631	1,695	1,857	2,926	1,400
Exports: e/ Ore and concentrate	5,056	2,565	2,684	4,304	4,800
Ferrocerium and pyrophoric alloys	9	22	59	27	16
Shipments from Govt. stockpile excesses	802	364	-	-	-
Consumption, apparent	20,000	17,100	19,600	21,400	22,100
Price, dollars, yearend 1984: Monazite concentrates, 385 per metric ton; bastnasite concentrates, 2.14 per kilogram REO. Prices for processed rare earths, per kilogram: Mixed compounds, 1.85 (chloride) to 18.50 (oxalate); high-purity oxides, 19 (lanthanum) to 5,200 (lutetium); metal, 125 (cerium) to 14,200 (lutetium); mischmetal, 12.35.					
Stocks, producer and processor, yearend	W	W	W	W	W
Employment, mine and mill e/ 2/	275	303	266	321	330
Net import reliance 3/ as a percent of apparent consumption	14	4/	12	4/	-

3. Recycling: Insignificant.

4. Import Sources (1981-84): Monazite--Australia 96%, Malaysia 4%, Republic of South Africa <1%.

5. Tariff: In 1985, rare-earth oxides, excluding cerium oxide, imported from Malaysia had a special tariff rate of 3.7% ad valorem.

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Ore and concentrates 5/	601.12 & 601.45	Free	Free	Free
Cerium oxide, compounds	418.42 & 418.44	8.2% ad val.	7.2% ad val.	35.0% ad val.
Alloys, mischmetal	632.78	34¢/lb	32¢/lb	$2/lb
Ferrocerium and other pyrophoric alloys	755.35	25¢/lb + 3.0% ad val.	22¢/lb + 2.6% ad val.	$2/lb + 25.0% ad val.

6. Depletion Allowance: Monazite, 22% on thorium content and 14% on rare-earth content (Domestic), 14% (Foreign). Bastnasite and xenotime, 14% (Domestic and Foreign).

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
1/ See also Yttrium and Thorium.
2/ Total employment at a rare-earth mine in California and at heavy minerals sands operations in Florida. The latter mine produced monazite concentrate as a byproduct of mining rutile, ilmenite, and zircon, and employees were not assigned to specific commodities.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ Increase in industry stocks exceeded net imports.
5/ "Concentrates" includes only those made by crushing, flotation, washing, or by other physical or mechanical processes that do not involve substantial chemical change.
6/ See page 182 for definitions.
7/ Comprises only the rare earths derived from bastnasite.

Prepared by J. B. Hedrick, telephone number (202) 634-1082.

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7. Government Stockpile:

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
REO in sodium sulfate	-	457	-	-

8. Events, Trends, and Issues: World and domestic demand for the rare earths in 1985 increased from 1984 levels. Strong demand for rare earths used in permanent magnets continued. Samarium supplies for use in samarium-cobalt magnets remained tight, while demand for neodymium and small amounts of dysprosium, used in recently developed neodymium-iron-boron magnets, showed strong growth. The more abundant rare earths, cerium, praseodymium, and lanthanum, and certain less abundant elements, holmium, thulium, ytterbium, and lutetium, were plentiful. Markets for europium and yttrium remained strong during 1985 while demand for terbium and erbium showed moderate growth. Demand for the rare earths in mischmetal and ferroalloys remained at about the same level as last year, while demand for rare earths in petroleum catalysts decreased slightly. From a 1983 base, demand for rare earths is expected to increase at an average annual rate of about 3% through 1990. It is estimated that in 1986 domestic mine production of rare earths 2/ and U.S. apparent consumption will each be 23,000 tons.

Except for samarium, the rare earths were in abundant domestic and world supply, and no critical shortages of any of them were anticipated. The demand pattern continued to shift toward individual compounds and metals and special mixtures, such as those used in phosphors, permanent magnets, lasers, fuel cells, and electronics. Although the capacity to process individual rare earths was limited, processors worldwide were increasing separation capacities to meet the changing demand pattern. Improved knowledge of rare-earth properties was leading to new commercial applications.

9. World Mine Production and Reserve Base:

	Mine Production e/		Reserve Base 6/
	1984	1985	
United States	7/25,311	7/22,000	5,200,000
Australia	9,189	8,250	260,000
Brazil	1,100	1,100	73,000
Canada	-	-	197,000
India	2,200	2,200	2,500,000
Malaysia	2,563	2,000	35,000
Thailand	172	170	1,100
Other Market Economy Countries	170	170	950,000
China	8,000	10,000	38,000,000
Other Centrally Planned Economies	1,500	1,500	500,000
World Total (rounded)	50,000	47,000	48,000,000

10. World Resources: Some elements of the rare-earth group of metals are relatively abundant in the earth's crust, but minable concentrations are uncommon. Bastnasite (a fluocarbonate) is mined extensively in the United States and China. Monazite (a phosphate) is recovered largely as a byproduct of processing heavy minerals sands in various parts of the world, primarily Australia and India. The rare earths also occur in many other minerals and are recoverable as byproducts from phosphate rock and from spent uranium leach solutions. Total world undiscovered resources of rare earths are believed to be very large relative to expected demand.

11. Substitutes: Substitutes are available for many applications of rare-earth elements, but generally are less effective. In major use categories, arsenic and selenium are substitutes for REO and cerium oxide in decolorizing glass. Oxides of iron, aluminum and zirconium can replace cerium oxide and cerium concentrates in glass polishing. Magnesium and calcium alloys and compounds may be used in place of mischmetal and rare-earth silicide as alloying agents in iron and steel. Palladium and ultrastable zeolites can be used in petroleum cracking catalysts as substitutes for rare earth-containing zeolites.

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RHENIUM

(Data in pounds of rhenium content, unless noted)

1. Domestic Production and Use: During 1985, rhenium was produced by eight companies. Rhenium was produced from porphyry copper deposits in the southwestern United States and was recovered as a byproduct of roasting molybdenum concentrates. Rhenium-containing products included ammonium perrhenate, perrhenic acid, and metal powder. Platinum-rhenium reforming catalysts continued to be the major end use product and accounted for about 90% of rhenium consumption. These catalysts were used to increase the octane rating in the production of lead-free petroleum products. About 10% of the rhenium was used in the production of thermocouples, heating elements, x-ray tubes and targets, flashbulbs, vacuum tubes, electrical contacts, metallic coatings, and for research and development. The estimated value of rhenium consumed in 1985 was $2.9 million.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Content 1/	15,800	11,200	8,100	8,600	8,700
Recovered 2/	W	W	W	W	W
Imports for consumption	9,669	5,369	6,570	8,752	6,000
Exports			Negligible		
Consumption: Reported e/	6,600	5,900	8,800	10,200	10,500
Apparent	W	W	W	W	W
Price, average value, dollars per pound:					
Metal powder, 99.99% pure	590	410	300	300	300
Perrhenic acid	510	375	250	200	200
Stocks, yearend, consumer, producer, dealer	W	W	W	W	W
Employment			Small		
Net import reliance 3/ as a percent of apparent consumption	W	W	W	W	W

3. Recycling: Small amounts of molybdenum-rhenium and tungsten-rhenium scrap have been processed during the past few years by several companies.

4. Import Sources (1981-84): Chile 63%, Federal Republic of Germany 32%, Other 5%.

5. Tariff: In 1985, rhenium imported from Chile had special tariff rates of 4.2% ad val., perrhenic acid; 3.7% ad val., unwrought metal; and 5.5% ad val., wrought metal.

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Unwrought metal, waste, and scrap 4/	628.90	3.9% ad val.	3.7% ad val.	25% ad val.
Wrought metal	628.95	5.9% ad val.	5.5% ad val.	45% ad val.
Ammonium perrhenate	417.4420	3.2% ad val.	3.1% ad val.	25% ad val.
Perrhenic acid	416.4540	4.4% ad val.	4.2% ad val.	25% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
1/ Calculated rhenium contained in MoS_2 concentrates.
2/ In prior years, this was shown as mine production.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ Duty on waste and scrap suspended indefinitely.
5/ See page 182 for definitions.

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8. Events, Trends, and Issues: During 1985, the rhenium price remained level. The average price was $300 per pound for rhenium metal and $200 per pound for ammonium perrhenate. Imports of rhenium decreased an estimated 31% from those of 1984. Chile and the Federal Republic of Germany continued to supply the majority of the rhenium imported. The United States relies on imports for most of its supply of rhenium.

From a 1983 base, domestic demand for rhenium is expected to increase at an average annual rate of about 3.5% through 1990. It is estimated that in 1986 U.S. consumption of rhenium will be about 10,000 pounds.

Due to the scarcity and minor output of rhenium, its production and processing pose no known threat to the environment. In areas where it is recovered, pollution control equipment for sulfur dioxide also prevents most of the rhenium from escaping into the atmosphere.

The main problems related to rhenium are: The low recovery of rhenium from porphyry copper ores; uncertain economic return on recovery equipment due to uncertain future prices and long-term demand; increased use of petroleum reforming catalysts containing no rhenium; and environmental costs imposed on the copper and molybdenum industries which recover rhenium as a byproduct.

9. World Mine Production and Reserve Base:

	Mine Production 1/		Reserve Base 5/
	1984	1985 e/	
United States	8,600	8,700	10,000,000
Canada	9,400	9,600	3,400,000
Chile	8,300	9,000	5,600,000
Peru	600	600	1,200,000
U.S.S.R.	6,000	6,000	1,700,000
Other Countries	700	700	800,000
World Total	33,600	34,600	22,700,000

10. World Resources: Most rhenium occurs with molybdenum in porphyry copper deposits. Identified U.S. resources are estimated to be about 10 million pounds, and the identified resources of the rest of the world are approximately 13 million pounds. In the U.S.S.R., rhenium also exists in sedimentary copper deposits.

11. Substitutes: Substitutes for rhenium in platinum-rhenium catalysts are being evaluated continually. Iridium has achieved commercial success in one such application. Other metals being evaluated for catalytic use include gallium, germanium, indium, selenium, silicon, tin, tungsten, and vanadium. The use of these and other metals in bimetallic catalysts may erode rhenium's share of the catalyst market. Materials that can substitute for rhenium in various end uses are: Cobalt and tungsten for coatings on copper x-ray targets; rhodium and rhodium-iridium for high temperature thermocouples; tungsten and platinum-ruthenium for coatings on electrical contacts; and tungsten and tantalum for electron emitters.

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RUBIDIUM 1/

(Data in pounds of rubidium content, unless noted)

1. Domestic Production and Use: One domestic company manufactured rubidium products from lepidolite ore imported from Canada. Small quantities of rubidium, usually in the form of chemical compounds, were used mainly in research and development. Rubidium also was used in electronic and medical applications.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Mine			None		
Metal and compounds	W	W	W	W	W
Imports for consumption:					
Ores and raw materials	-	e/4,700	-	W	2,400
Rubidium metal and compounds		Not available			
Exports		Not available			
Consumption, apparent, metals and compounds		Not available			
Price, dollars per pound:					
Metal, 99.5%+, 1-4 pound lots	300	300	300	300	300
Rubidium compounds, range	65-110	78-132	84-132	90-142	100-145
Rubidium oxide	NA	500	500	500	500
Stocks, producer, yearend	W	W	W	W	W
Employment, plant e/	25	25	25	25	25
Net import reliance 2/ as a percent of apparent consumption	NA	NA	NA	100	100

3. Recycling: None.

4. Import Sources (1981-84): Canada, 100%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Rubidium	415.40	3.9% ad val.	3.7% ad val.	25.0% ad val.
Rubidium compounds	423.00	3.9% ad val.	3.7% ad val.	25.0% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
1/ See also Cesium.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 182 for definitions.

Prepared by W. Timothy Adams, telephone number (202) 634-1082.

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8. Events, Trends, and Issues: In 1985, rubidium and its compounds were largely the subject of laboratory study and were of little commercial significance. No major breakthroughs or developments were anticipated that would change the production or consumption pattern in 1986. From a 1983 base, demand for rubidium is expected to increase at an average annual rate of about 3.1% through 1990. Domestic rubidium production is entirely dependent on imported lepidolite ores. Because of the small scale of production of rubidium products, no significant environmental problems have been encountered.

9. World Mine Production and Reserve Base: The Canadian mining operation for lepidolite ore remained closed during 1985. The reserve base 3/ for rubidium in North America was estimated at 5 million pounds.

10. World Resources:3/ Rubidium forms no known minerals in which it is the predominant metallic constituent, but occurs chiefly as a replacement for potassium, especially in minerals formed late in the crystallization of pegmatites. Meaningful estimates of rubidium resources cannot be made, but pollucite deposits contain about 1% rubidium.

11. Substitutes: The properties of cesium and its compounds are so similar to those of rubidium and its compounds that compounds of rubidium and cesium are used interchangeably in many applications. Cesium, germanium, tellurium, selenium, silicon, and several other elements and compounds can substitute for rubidium as photosensitive materials.

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RUTILE 1/

(Data in thousand short tons of concentrate, unless noted)

1. Domestic Production and Use: Rutile was produced at one mine in Florida in 1985. At two other mines in Florida, rutile was included in a bulk concentrate containing mostly ilmenite and leucoxene. The major coproduct of these titanium minerals is zircon. The value of reported U.S. rutile consumption in 1985, assuming an average price of $330 per ton, was about $96 million. Of 25 consuming firms, located mainly in the Eastern United States, 5 companies used 84% of the rutile consumed to make titanium dioxide pigment. Welding rod coatings consumed 1%; miscellaneous applications, which include titanium metal and glass fibers, 15%. Five firms in Nevada, Ohio, Oregon, and Washington used titanium tetrachloride made from rutile to manufacture titanium metal.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production	W	W	W	W	W
Imports for consumption 2/	202	163	112	181	195
Exports e/	7	2	4	5	15
Shipments from Govt. stockpile excesses			None		
Consumption: Reported 2/	285	239	266	318	320
Apparent	W	W	W	W	W
Price, dollars per ton, yearend:					
f.o.b. Atlantic and Great Lakes ports, spot	460	460	415	475	475
Bulk, large lots, f.o.b. Titen, FL	350	310	310	330	330
Synthetic, f.o.b. Mobile, AL	340	350	350	350	350
Stocks, mine, distributor and consumer, yearend	163	176	130	105	100
Employment, mine and mill 3/	371	361	336	382	410
Net import reliance 4/ as a percent of apparent consumption	W	W	W	W	W

3. Recycling: None.

4. Import Sources (1981-84): Australia 66%, Sierra Leone 19%, Republic of South Africa 13%, Other 2%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Rutile ore	601.5140	Free	Free	Free
Synthetic rutile	603.7010	5.6% ad val.	5.0% ad val.	30.0% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile:

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Stockpile grade	106	39	-	-

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
1/ See also Ilmenite and Titanium.
2/ Including synthetic rutile.
3/ Employment at three sand deposit operations in Florida, which produced either rutile concentrate or a titanium mineral concentrate, where ilmenite and zircon were major coproducts, and where employees were not assigned to specific commodities.
4/ Defined as imports - exports + adjustments for Government and industry stock changes.
5/ See page 182 for definitions.
6/ Excluding U.S. production.

Prepared by L. E. Lynd, telephone number (202) 634-1073.

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8. Events, Trends, and Issues: Production of rutile increased in 1985. Production of synthetic rutile at the only U.S. synthetic rutile plant at Mobile, AL, also increased. Production of natural rutile in Australia, which in 1984 was the source of about 50% of the world's supply, was about the same as in 1984. U.S. imports from Australia of natural and synthetic rutile totaled 90,000 tons, 4% less than in 1984. Synthetic rutile imports in 1985 were about 33,000 tons compared with 22,000 tons in 1984, and came entirely from Australia. It is estimated that in 1986 reported consumption of rutile will rise to 310,000 tons, reflecting increased demand for titanium dioxide. From a 1984 base, demand for natural and synthetic rutile is expected to increase at an average annual rate of about 1.5% through 1990.

A major impediment to more extensive use of natural rutile is the limited supply. On the east coast of Australia, the reserve base of rutile is about 8 million tons but because of environmental concerns, only about 5 million tons can be mined. Deposits on Australia's west coast contain 2 million tons of minable rutile. Production in Sierra Leone increased to near capacity levels in 1984 and 1985, and output in the Republic of South Africa was also close to full capacity.

Mining of rutile is entirely from sand deposits which contain only a few percent of valuable minerals. While the discarded sand can be readily returned to the mined area, regraded and seeded to aid restoration of the environment, there has been continuing pressure to curtail sand mining in some areas.

Fewer environmental pollution problems are encountered when pigment is made from rutile rather than ilmenite. The chloride process, using a rutile feed, generates about 0.2 ton of waste per ton of titanium dioxide product, while the alternate sulfate process, using ilmenite, generates about 3.5 tons of waste per ton of product. Producing synthetic rutile from ilmenite results in about 0.7 ton of waste, mainly iron oxide, per ton of product. Direct chlorination of ilmenite generates about 1.2 tons of waste, mainly ferric chloride, per ton of titanium dioxide.

The sole Australian producer of synthetic rutile announced plans to install 124,000 tons per year of additional capacity by 1987, and a joint venture by Australian, British, and Japanese firms was to build a 110,000-ton-per-year synthetic rutile plant, also to be completed by 1987, bringing total Australian synthetic rutile capacity to about 300,000 tons per year, all in Western Australia.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 5/
	1984	1985 e/	
United States	W	W	1,700
Australia	200	200	10,000
Brazil e/	1	-	88,000
India e/	8	9	5,000
Italy	-	-	15,000
Sierra Leone e/	101	100	2,500
South Africa, Republic of e/	62	62	5,300
Sri Lanka	9	10	900
Centrally Planned Economies e/	11	11	5,000
World Total	6/392	6/392	133,400

10. World Resources: Identified world resources of rutile (including anatase) total about 200 million tons of contained TiO_2. Major rutile resources occur in Australia, India, Italy, Sierra Leone, the Republic of South Africa, and the United States. The Brazilian resources are mainly anatase, and were reportedly being developed.

11. Substitutes: Ilmenite, titaniferous slag, and synthetic rutile made from ilmenite may be used instead of natural rutile for making pigment, metal, or welding rod coatings.

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SALT

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: The quantity of all forms of salt sold or used by producers in 1985 increased an estimated 1% compared with that of 1984, and the value increased from $675 million in 1984 to about $690 million in 1985. Forty-one companies operated 73 plants in 15 States, with the 9 largest companies accounting for over 77% of the salt sold or used.

   The chemical industry consumed about 49% of the salt sold or used by producers. Most of the salt used by the chemicals sector was for manufacturing chlorine and caustic soda. Salt used for highway deicing accounted for approximately 24% of the domestic salt demand. Paper and food products, agriculture, water treatment, petroleum, metal production, and several other minor applications constituted the remaining end uses of salt.

   Based on final 1984 data, the estimated percentage of salt sold or used by type in 1985 was salt in brine, 50%; rock salt, 35%; vacuum and open-pan evaporated salt, 9%; and solar evaporated salt, 6%.

2. Salient Statistics--United States: 1/

	1981	1982	1983	1984	1985 e/
Production	38,899	37,665	32,973	39,181	39,600
Sold or used by producers	38,907	37,894	34,573	39,225	39,700
Imports for consumption	4,319	5,451	5,997	7,545	6,600
Exports	1,046	1,001	517	820	1,200
Consumption, apparent	42,180	42,344	40,053	45,950	45,100
Price, average value, dollars per ton, f.o.b. mine/plant:					
Vacuum and open pan salt	79.68	86.72	87.39	92.62	90.00
Solar salt	18.35	17.89	21.47	19.67	20.00
Rock salt	13.76	13.89	13.43	13.78	14.00
Salt from brine	5.91	6.21	5.22	5.05	4.50
Pressed blocks, all sources	66.14	67.83	71.52	63.82	65.00
Stocks, producer, yearend e/	2,663	2,434	834	790	690
Employment, mine and plant	5,600	5,000	5,000	4,700	4,700
Net import reliance 2/ as a percent of apparent consumption	8	11	18	15	12

3. Recycling: None.

4. Import Sources (1981-84): Canada 40%, Mexico 25%, Bahamas 15%, Chile 6%, Other 14%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
In brine	420.92	3.9% ad val.	3.7% ad val.	20% ad val.
In bulk	420.94	0.4% ad val.	Free	26% ad val.
Other	420.96	Free	Free	11¢/100 lbs

6. Depletion Allowance: 10% (Domestic), 10% (Foreign).

7. Government Stockpile: None.

e/ Estimated.
1/ Excluding Puerto Rico.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 182 for definitions.

Prepared by D. S. Kostick, telephone number (202) 634-1177.

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8. Events, Trends, and Issues: Acting on a petition filed by a domestic salt producer at the beginning of the year, the U.S. Department of Commerce preliminarily determined that Canadian rock salt was, or was likely to be, sold at less than fair value in the United States. Two Canadian salt producers accounted for about 70% of total Canadian exports to the United States. A final decision was expected by yearend.

Excess capacity in the domestic chlorine-caustic soda industry and slow growth in demand for chloralkali-based products, created economic problems for several producers that resulted in the closure of two chloralkali plants with captive salt brine operations in Michigan and West Virginia.

At midyear, a solar salt facility on the Great Salt Lake in Utah was sold because of production problems arising from flooded evaporation ponds.

From a 1983 base, demand for salt is expected to increase at an average annual rate of about 2.2% through 1990. It is estimated that in 1986 domestic mine production of salt will be 39.8 million tons and U.S. apparent consumption will be 45.3 million tons.

9. World mine Production and Reserve Base:

	Mine Production 1984	Mine Production 1985 e/	Reserve Base 3/
United States (sold or used) 1/	39,225	39,700	Large
Australia	5,500	6,000	
Canada	11,347	11,500	Reserves are large in
France	7,860	7,800	principal salt-producing
Germany, Federal Republic of	12,300	12,300	countries but grades are
India	8,306	8,300	unknown. The oceans
Italy	4,688	4,600	comprise an inexhaustible
Mexico	6,600	6,500	supply of salt.
United Kingdom	7,160	7,100	
Other Market Economy Countries	31,682	32,000	
China	17,600	18,000	
Poland	4,000	4,000	
U.S.S.R.	18,200	18,500	
Other Centrally Planned Economies	10,664	10,600	
World Total	185,132	186,900	

10. World Resources: World resources of salt are virtually unlimited. Domestic resources of rock salt and salt from brine are located in the northeast, central western, and southern Gulf Coast States. Saline lakes and solar evaporated salt facilities are close to populated regions in the Western United States. Nearly every country in the world has salt deposits or solar evaporation operations of various sizes.

11. Substitutes: There were no economic substitutes or alternates for salt. Calcium chloride, hydrochloric acid, and potassium chloride can be substituted for salt in deicing, certain chemical processes, or food flavoring, but at higher cost.

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SAND AND GRAVEL

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Construction sand and gravel valued at $2.4 billion was produced by about 4,300 companies from about 5,900 operations in 50 States. Leading States in order of volume were California, Texas, Michigan, Arizona, Ohio, Alaska, New York, Colorado, Illinois, and Minnesota, which accounted for about 52% of the total output. About 44% of this tonnage was used as aggregate in concrete for residential and nonresidential buildings, highways, bridges, dams, waterworks and airports, and other concrete products; 25% in roadbases and coverings; 15% as asphaltic concrete aggregates and other bituminous mixtures; 11% for construction fill; and 5% was for railroad ballast, snow and ice control, and other.

   Industrial sand and gravel valued at $390 million was produced by 97 companies from 176 operations in 35 States. Leading States in order of volume were Illinois, Michigan, New Jersey, California, and Texas. Their combined production represented 49% of the national total. About 40% of this tonnage was used as glassmaking sand, 25% as foundry sand, 7% as abrasive sand, 7% as hydraulic fracturing sand, and 21% for other miscellaneous or unspecified uses.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Construction sand and gravel:					
Production	e/690,000	594,000	e/655,100	773,900	800,000
Imports for consumption	333	185	123	151	150
Exports	1,265	1,128	1,303	1,845	1,900
Consumption, apparent	e/689,000	593,100	e/653,900	772,200	800,000
Price, average value, dollars per ton	e/2.79	2.82	e/2.90	2.90	3.00
Stocks, yearend		Not available			
Employment, quarry and mill e/	46,000	44,000	45,000	46,000	46,000
Net import reliance 1/ as a percent of apparent consumption		Net exporter			
Industrial sand and gravel:					
Production	29,980	27,400	26,620	29,380	29,900
Imports for consumption	4	90	58	26	30
Exports	1,132	818	1,047	1,193	1,000
Consumption, apparent	28,900	26,700	25,600	28,200	28,900
Price, average value, dollars per ton	11.08	11.82	12.59	12.84	12.90
Stocks, yearend		Not available			
Employment, quarry and mill e/	1,600	1,500	1,500	1,600	1,600
Net import reliance 1/ as a percent of apparent consumption		Net exporter			

3. Recycling: Asphalt road surfaces and cement concrete surfaces were recycled on a limited but increasing basis.

4. Import Sources (1981-84): Construction sand and gravel: Canada 83%, Other 17%. Industrial sand and gravel: Australia 72%, Bahamas 10%, Canada 10%, Other 8%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
95% or more silica and not more than 0.6% iron oxide	513.11	$0.06/lt	Free	$2.00/lt
Other	513.14	Free	Free	Free

6. Depletion Allowance: (Domestic and Foreign)
   Sand and Gravel: Common varieties 5%, industrial sand or pebbles 14%.

7. Government Stockpile: None.

e/ Estimated. NA Not available.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ See page 182 for definitions.

Prepared by L. L. Davis, telephone number (202) 634-1184, for construction sand and gravel.
Prepared by V. V. Tepordei, telephone number (202) 634-1185, for industrial sand.

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8. Events, Trends, and Issues: Construction sand and gravel output increased slightly in 1985. It is estimated that 1986 domestic production and U.S. apparent consumption will be about 810 million tons each. From a 1984 base, demand for construction sand and gravel is expected to increase at an average annual rate of 2.5% through 1990, giving a probable forecast demand in 1990 of about 900 million tons.

Industrial sand and gravel output increased in 1985 by about 2%. It is estimated that 1986 domestic production and U.S. apparent consumption will be 30 million and 29 million tons, respectively. From a 1983 base, demand for industrial sand and gravel is expected to increase at an average annual rate of 2.2% through 1990, giving a probable forecast demand in 1990 of about 33 million tons.

The sand and gravel industry continued to be concerned with safety regulations and environmental restrictions in 1985. Shortages in urban and industrialized areas were expected to continue to increase due to local zoning regulations and land development alternatives. This was expected to continue to cause a movement of sand and gravel operations from high population centers.

9. World Mine Production and Reserve Base:

	Mine Production e/		Reserve Base 2/
	1984	1985	
United States	803,280	830,000	The reserve base is controlled largely by land use and/or environmental constraints. Local shortages of sand or gravel are common.
Other countries	NA	NA	

10. World Resources: Sand and gravel resources of the world are large. However, due to their geographic distribution, environmental restrictions, and quality requirements for some uses, their extraction is sometimes uneconomic. The most important commercial sources of sand and gravel have been river flood plain, river channel, and glacial deposits. Marine deposits could become important in the future. Quartz-rich sand and sandstones, the main source of industrial silica sand, occur throughout the world.

11. Substitutes: Crushed stone remains the predominant alternative for construction aggregate use. Silica sand continues to be the major material used for glassmaking and for foundry and molding sands; alternates are zircon, olivine, staurolite, and chromite sands.

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SELENIUM

(Data in metric tons of selenium content, unless noted)

1. Domestic Production and Use: Primary selenium was recovered as a byproduct from anode slimes generated in the electrolytic refining of copper. In 1985 output was valued at an estimated $5 million. Four copper refineries, located one each in New Jersey and Utah, and two in Texas, accounted for the domestic production of selenium. The estimated consumption of selenium by end use was electronic and photocopier components, 35%; glass manufacturing, 30%; chemical and pigments, 25%; and other, 10%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, refinery	252	243	354	254	195
Imports for consumption, metal and compounds	312	347	297	377	392
Exports, metal, waste, and scrap	61	117	93	123	174
Consumption, apparent	459	538	578	478	425
Price, dealers', average, dollars per pound, 100-pound lots, commercial grade	4.38	3.53	3.87	9.02	7.50
Stocks, producer, (refined metal only) yearend	151	87	67	97	85
Employment		Not available			
Net import reliance 1/ as a percent of apparent consumption	45	55	39	47	54

3. Recycling: Due to the high cost of recovery and the decrease in price of old scrap in 1981, domestic production of secondary selenium was discontinued in 1982 and none has been produced since that date. Old scrap, mostly from xerographic material, was exported for processing to recover secondary selenium. It was estimated that 100 tons of secondary metal was imported in 1985.

4. Import Sources (1981-84): Canada 38%, United Kingdom 20%, Japan 14%, Belgium-Luxembourg 9%, Other 19%.

5. Tariff:

	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-NFM 1/1/86
Selenium metal	632.40	Free	Free	Free
Selenium dioxide and salts	420.50 & 420.52	Free	Free	Free
Other selenium compounds	420.54	3.9% ad val.	3.7% ad val.	25.0% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. NA Not available.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ See page 182 for definitions.
3/ Excluding Other Market Economy Countries and Centrally Planned Economies.

Prepared by N. L. Jensen, telephone number (202) 634-1063.

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8. Events, Trends and Issues: Domestic production of refined selenium decreased by 23% from the 1984 level. Imports increased by 4%, and exports increased by 41%. The U.S. dealer price for commercial-grade selenium was $9.25-$10.25 in January and declined steadily to $6.25-$7.25 in June. Thereafter, the price remained in the $7.25-$7.50 range. From a 1983 trend line value of 495 tons, demand for selenium is expected to increase at an average annual rate of about 2% through 1990. It is estimated that in 1986 domestic refinery production and U.S. apparent consumption will be about 195 and 450 metric tons, respectively. The New Jersey refinery sharply curtailed production in 1983, and the Utah refinery discontinued production in 1985.

9. World Refinery Production and Reserve Base:

	Plant Production		Reserve Base 2/
	1984	1985 e/	
United States	254	195	19,000
Belgium	60	60	-
Canada	448	450	15,000
Chile	40	40	21,000
Finland	11	10	-
Japan	465	465	-
Mexico	26	25	5,000
Peru	20	20	7,000
Sweden	45	45	-
Yugoslavia	45	45	1,000
Zambia	17	15	7,000
Other Market Economy Countries	NA	NA	25,000
Centrally Planned Economies	NA	NA	18,000
World Total (may be rounded)	3/1,430	3/1,370	120,000

10. World Resources: In addition to the above large reserve base of byproduct selenium which is contained in identified copper deposits of economic grade, 2.5 times this quantity of byproduct metal is believed to exist in copper or other metal deposits that are undeveloped, of uneconomic grade, or as yet undiscovered. Coal contains an average of 1.5 parts per million of selenium, but although the selenium content of coal deposits is about 80 times the content of identified economic copper deposits, recovery of selenium from coal appears unlikely in the foreseeable future.

11. Substitutes: High-purity silicon is the major substitute for selenium in its application as a semiconductor in rectifiers, and has already taken over selenium rectifier usage in high-voltage equipment. Other inorganic semiconductor materials, such as silicon, cadmium, tellurium, gallium, and arsenic, as well as organic photoconductors, may substitute for selenium in photoelectric applications. Other substitutes include cerium oxide in glass manufacturing, tellurium in pigment and rubber compounding, and tellurium, bismuth, and lead in the production of free-machining metals.

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SILICON

(Data in thousand short tons of silicon content, unless noted)

1. Domestic Production and Use: Estimated value of silicon metal and alloys (excluding semiconductor grade silicon) produced in the United States in 1985 was $420 million. Ferrosilicon was produced by 10 companies in 13 plants while production of silicon metal was divided among 6 companies in 7 plants. Most of the ferrosilicon and silicon metal plants were located east of the Mississippi River or in the Pacific Northwest. Most ferrosilicon was consumed in the ferrous foundry and steel industries located predominantly in the eastern half of the United States. The main consumers of silicon metal were aluminum producers located throughout the United States and the chemical industry. End uses of silicon were: Transportation, 31%; chemicals, 19%; machinery, 17%; construction, 14%; and other, 19%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production	476	279	333	454	400
Imports for consumption	139	78	133	121	150
Exports	17	10	9	20	8
Consumption, apparent	575	363	480	551	520
Price, average, cents per pound Si:					
Ferrosilicon 50% Si	46.1	45.3	42.1	42.9	45.0
Silicon metal max. 1% Fe	64.9	62.4	57.2	62.9	63.3
Stocks, producer and consumer, yearend	125	109	86	90	110
Employment, plant e/	3,500	2,500	2,500	2,600	2,500
Net import reliance 1/ as a percent of apparent consumption	17	23	31	18	23

3. Recycling: Insignificant.

4. Import Sources (1981-84): Brazil 23%, Canada 20%, Norway 17%, Venezuela 13%, Other 27%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Ferrosilicon, 8-60% Si	606.35	Free	Free	2.0¢/lb. Si
Ferrosilicon, 60-80% Si:				
Over 3% Ca	606.36	1.1% ad val.	1.1% ad val.	11.5% ad val.
Other	606.37	1.6% ad val.	1.5% ad val.	11.5% ad val.
Ferrosilicon, 80-90% Si	606.39	1.9% ad val.	1.9% ad val.	9.0% ad val.
Ferrosilicon, over 90% Si	606.40	6.5% ad val.	5.8% ad val.	40.0% ad val.
Silicon, 96.0-99.0% Si	632.86	9.0% ad val.	9.0% ad val.	45.0% ad val.
Silicon, 99.0-99.7% Si	632.42	5.3% ad val.	5.3% ad val.	21.0% ad val.
Silicon, over 99.7% Si	632.43	3.9% ad val.	3.7% ad val.	25.0% ad val.

6. Depletion Allowance: Quartzite, 14% (Domestic and Foreign); gravel, 5% (Domestic and Foreign).

7. Government Stockpile:

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Silicon carbide, crude short tons, gross weight	29,000	80,550	0	-

e/ Estimated.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ See page 182 for definitions.

Prepared by G. F. Murphy, telephone number (202) 634-1024.

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8. Events, Trends, and Issues: Demand for silicon ferroalloys follows closely the scheme of overall iron and steel production whereas demand for silicon metal largely depends on the health of the aluminum and chemical industries. Owing to a falloff in demand by the iron and steel industry, which began at the end of the first quarter, and also by the aluminum industry, prices for a number of domestically produced silicon materials either remained unchanged or decreased slightly in 1985. For example, published prices, on a cents per pound of contained silicon basis, remained constant throughout the year at 45.0¢ for 50% ferrosilicon and 47.0¢ for 75% ferrosilicon. Silicon metal containing up to 1% iron and 0.07% calcium began the year at 63.7¢ but was lowered slightly to a range of 62.0¢-63.7¢ on September 24. Following a similar trend, silicon metal containing up to 0.35% iron and 0.07% calcium was lowered from 68.9¢ to a range of 67.3¢-68.9¢ on September 24. Posted prices for imported silicon materials remained significantly lower than those for domestically produced materials. From a 1983 base, demand for silicon is expected to increase at an average annual rate of about 3.7% through 1990. It is estimated that in 1986 domestic production of silicon metal and alloys will be 360,000 tons and U.S. apparent consumption will be 540,000 tons.

Bills S. 262 and H.R. 976 entitled "Fair Trade in Ferroalloys Act" were introduced in the U.S. Senate on January 24 and in the House of Representatives on February 6, respectively. The bills, designed to preserve the domestic ferroalloy industry, would provide for the automatic imposition of tariffs on materials entering the United States below a "fair price." On May 21, the U.S. Senate adopted an amendment (No. 168) to the Department of Defense fiscal year 1986 Authorization bill, S. 1160. The amendment requires the Department of Defense to conduct a study to determine what impact the loss of all domestic ferroalloy production capacity would have on the U.S. industrial base and military preparedness.

Federal funding budgeted for photovoltaic research amounted to $44.8 million in 1986 compared with an actual outlay of $49.0 million in 1985. The Department of Commerce continued controls on exports to the U.S.S.R. of both electronic-grade polycrystalline and monocrystalline silicon.

9. World Production and Reserve Base:

	Production		Reserve Base 2/
	1984	1985 e/	
United States	454	400	The reserve base in most major producing countries is ample in relation to demand. Quantitative estimates are not available.
Brazil	144	160	
Canada	79	80	
France	166	170	
Italy	53	60	
Japan	115	120	
Norway	414	410	
South Africa, Republic of	118	110	
Spain	67	70	
Yugoslavia	130	140	
Other Market Economy Countries	381	380	
U.S.S.R.	565	560	
Other Centrally Planned Economies	326	320	
World Total	3,012	2,980	

10. World Resources: World and domestic resources for making silicon metal and alloys are abundant, but these deposits are not always near market areas. Resources in most alloy metal producing countries are adequate to supply world requirements for many decades.

11. Substitutes: Various metals and alloys, such as aluminum and silicomanganese, can be substituted for silicon in some applications. Germanium is the principal substitute for silicon in semiconductor and infrared applications.

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SILVER

(Data in million troy ounces of silver content, unless noted)

1. Domestic Production and Use: Silver was produced from about 150 mines in 16 States and had an estimated value of $267 million. Five States accounted for 87% of the 1985 mine production: Idaho, 49%; Nevada, 14%; Montana, 9%; Arizona, 9%; and Missouri, 5%. Ten mines produced about 65% of the silver mined. There were 22 principal refiners of commercial-grade silver, located primarily in northeastern States. Fabricating and manufacturing firms were estimated to number over 5,000. The photographic industry is located primarily in New York and other end-use manufacturing firms are mainly in Connecticut, New York, Rhode Island, and New Jersey. Silver consumption in 1985 by end use was: Photography, 48%; electrical and electronic products, 25%; sterlingware, electroplated ware, and jewelry, 12%; brazing alloys and solders, 5%; and other, 10%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Mine	40.7	40.2	43.4	44.4	43.0
Refinery--Primary	47.0	44.2	50.4	49.0	46.0
Secondary (old scrap)	39.1	27.2	25.5	24.1	26.0
Imports for consumption 1/	94.1	117.5	179.9	115.0	158.0
Exports 1/	27.9	25.5	32.0	24.4	28.0
Shipments from Govt. stockpile excesses	2.0	-	-	-	-
Consumption: Reported--Industrial	116.7	118.8	116.5	114.8	115.0
Coinage	0.2	1.8	2.1	2.7	0.4
Apparent 2/	168.6	150.0	176.2	169.0	192.0
Price, average, New York, dollars per ounce	10.52	7.95	11.44	8.14	6.20
Stocks, yearend: Treasury Department 3/	38.7	36.8	34.6	31.9	31.7
Industry, COMEX, CBT 4/	117.4	126.6	168.8	158.8	164.0
Department of Defense	3.8	1.8	0.1	0.3	0.3
Employment, mine and mill 5/	3,600	2,900	2,400	2,600	2,400
Net import reliance 6/ as a percent of apparent consumption	53	55	61	59	64

3. Recycling: About 26 million ounces of silver was recovered from old scrap in 1985, equivalent to 23% of reported consumption. Another 41 million ounces was recovered from new scrap.

4. Import Sources (1981-84): Canada 28%, Mexico 24%, Peru 17%, United Kingdom 15%, Other 16%.

5. Tariff: No duties were imposed on imports of unrefined silver or refined bullion. There were duties on items such as platinum- and gold-plated unwrought or semimanufactured silver, but these items constituted a minor portion of U.S. imports.

6. Depletion Allowance: 15% (Domestic), 14% (Foreign).

7. Government Stockpile:

		Stockpile Status--9-30-85		
Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Silver	-	137.5	10.0	-

e/ Estimated.
1/ Excludes coinage.
2/ Domestic primary metal production plus recovery from old silver scrap plus net imports; also includes net bullion purchased for investment purposes.
3/ Balance in Mint only.
4/ Industry: Refiner, fabricator, and dealer. COMEX: Commodity Exchange, Inc., New York. CBT: Chicago Board of Trade.
5/ Source, Mine Safety and Health Administration.
6/ Defined as imports - exports + adjustments for Government and industry stock changes.
7/ Includes silver recoverable as a byproduct of base-metal ores.
8/ See page 182 for definitions.

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8. Events, Trends, and Issues: U.S. production of silver declined in 1985 because of temporary closures and reduced operations at a number of mines in response to continuing low silver prices. The full impact of the closures and reductions was not realized however, because of byproduct silver production from several new gold mines which opened during the year. The amount of silver supplied to the U.S. market in 1985 from domestic primary and secondary sources and imports continued to exceed U.S. industrial demand. U.S. industrial consumption remained near the levels of consumption reported since 1980 reflecting in part the more efficient use of silver in electronic and photographic applications and the changing tastes of consumers for jewelry and sterlingware.

Speculator and investor activity, as distinguished from industrial demand, continued to be the primary determinant of silver price movements in 1985. Fluctuations in the U.S. dollar exchange rate, weak oil prices, banking industry problems, and sales of silver by private investors were among the factors believed to have influenced silver price movements during the year. Although the price fell below $6.00 several times in 1985, prices generally remained in the $6.00-$6.50 range throughout the year. The price began the year at $6.14 per ounce, falling to a low of $5.57 on March 12, and reaching the peak for the year of $6.72 on April 11. The average daily price declined from $8.14 in 1984 to $6.20 in 1985.

Trading activity in U.S. futures markets declined from the record levels of 1984. In March 1985, the Chicago Board of Trade (CBT) introduced and began trading silver options. Each option entitles the holder to either buy or sell one CBT futures contract representing 1,000 ounces of silver at a given price for a certain period of time.

On July 9, the President signed Public Law 99-61, the Statue of Liberty-Ellis Island Commemorative Coin Act. P.L. 99-61 authorized the U.S. Mint to produce 500,000 gold, 10 million silver, and 25 million cupronickel coins commemorating the centennial of the Statue of Liberty. Title III of P.L. 99-61 authorizes the production of a silver bullion coin upon completion of the Statue of Liberty coin program. Silver for both the Statue of Liberty coin program and the bullion coin program is to be obtained from the silver held in the National Defense Stockpile.

It is estimated that in 1986 domestic mine production of silver will be 43 million ounces and U.S. apparent consumption will be 170 million ounces. From a 1983 base, demand for silver is expected to increase at an average annual rate of about 0.8% through 1990.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 7/8/
	1984	1985 e/	
United States	44.4	43.0	1,800
Canada	37.6	38.0	1,400
Mexico	67.8	63.0	1,400
Peru	56.5	57.0	950
Other Market Economy Countries	114.3	115.0	3,200
U.S.S.R.	47.4	47.0	1,600
Other Centrally Planned Economies e/	30.5	31.0	400
World Total (may be rounded)	398.6	394.0	10,800

10. World Resources: Approximately two-thirds of world silver resources are associated with copper, lead, and zinc deposits. The remaining one-third is in vein deposits in which silver is the principal metallic component. While most recent discoveries have been primarily gold or silver deposits, significant future increases in reserves and resources are expected to come from major base metal discoveries that contain byproduct silver.

11. Substitutes: Aluminum and rhodium substitute for silver in mirrors and other reflecting surfaces. Tantalum can be used in place of silver for surgical plates, pins, and sutures. Stainless steel is an alternate material used widely in the manufacture of table flatware. Some of the batteries being developed may replace silver batteries in some applications. Silverless black and white film, film with reduced silver content, and xerography are alternatives to some uses of silver in photography.

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SODIUM CARBONATE (SODA ASH)

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Five companies in Wyoming and one in California comprised the natural soda ash industry. Their combined annual nameplate capacity was about 10.46 million tons. Synthetic soda ash was produced at Syracuse, NY, by one company with a 700,000-ton-per-year capacity. Sodium sulfate, potassium chloride, potassium sulfate, borax, and other minerals were produced as coproducts from sodium carbonate production in California. The total estimated value of domestic soda ash produced in 1985 was $660 million.

   Nearly 50% of the soda ash was used for manufacturing glass. The chemical industry consumed 23%; soaps and detergents, 9%; water treatment, 4%; pulp and paper, 4%; and other, 10%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, natural and synthetic	8,281	7,819	8,467	8,511	8,500
Imports for consumption	12	18	20	17	30
Exports	1,051	1,109	1,636	1,648	1,800
Consumption, apparent (natural and synthetic)	7,112	6,667	6,868	6,865	6,762
Price: Quoted, yearend, soda ash, natural, dense, bulk, f.o.b. Green River, WY, dollars per ton	92.00	84.00	69.00	79.00	83.00
F.o.b. Searles Valley, CA, same basis	106.25	107.25	92.25	109.25	113.25
F.o.b. Syracuse, NY, synthetic, same basis	132.00	132.00	132.00	132.00	132.00
Average sales value (natural source), f.o.b. mine or plant, dollars per ton	91.19	88.35	76.95	67.00	70.00
Stocks, producer, yearend	263	324	307	322	290
Employment, mine and plant	3,650	3,300	3,400	3,400	3,400
Net import reliance 1/ as a percent of apparent consumption		Net exporter			

3. Recycling: There is no recycling of soda ash by producers; however, container glass producers are using cullet glass, thereby reducing soda ash consumption.

4. Import Sources (1981-84): Canada 99%, Other 1%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Calcined (soda ash)	420.84	1.2% ad val.	1.2% ad val.	8.5% ad val.
Hydrated and sesquicarbonate	420.86	0.1¢/lb.	0.1¢/lb.	0.25¢/lb.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign). For natural only.

7. Government Stockpile: None.

e/ Estimated. NA Not available. 1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ The reported quantities are sodium carbonate only. About 1.8 tons of trona yields 1 ton of sodium carbonate.
3/ See page 182 for definitions.
4/ From trona, nahcolite, and dawsonite sources.
5/ Excluding Botswana and Uganda.
6/ Excluding Botswana, Chad, Kenya, and Uganda.

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8. Events, Trends, and Issues: Increased production of fiberglass and flat glass contributed to a rise in soda ash consumption in those sectors, but production of glass containers fell because of increased use of cullet and competition from plastic bottles, thereby substantially reducing soda ash demand.

A company in New York announced plans to permanently close its synthetic soda ash plant in January 1986, because of high operating costs and stagnant domestic demand for soda ash. The closure will reduce the domestic supply of light soda ash, preferred by the detergent industry, and sodium bicarbonate. A company with sodium carbonate leases in California announced plans to sell its half of a joint venture because of economic considerations of the parent company.

Effective July 1, 1985, the soda ash industry reduced the temporary voluntary allowance (TVA) on bulk soda ash by $4 per ton, which raised the Wyoming selling price to $83 per ton and the California price to $113.25 per ton.

The export market continued to be prosperous for the U.S. soda ash industry with export values averaging more than $98 per ton compared with the average domestic value of nearly $70 per ton.

From a 1983 base, demand for soda ash is expected to increase at an average annual rate of about 1% through 1990. It is estimated that in 1986 domestic mine production of sodium carbonate will be 8.0 million tons and U.S. apparent consumption will be 6.8 million tons.

9. World Mine Production and Reserve Base:

(Natural sources):	Mine Production 1984	Mine Production 1985 e/	Reserve Base 2/ 3/
United States (includes synthetic)	8,511	8,500	4/ 42,700,000
Botswana	NA	NA	NA
Chad	NA	NA	NA
Kenya	220	230	NA
Mexico (includes synthetic)	440	400	500,000
Uganda	NA	NA	NA
World Total (may be rounded)	5/ 9,170	5/ 9,130	6/ 43,200,000

10. World Resources: Soda ash is obtained from trona and sodium carbonate-rich brines. The world's largest deposit of trona is in the Green River Basin of Wyoming. About 52 billion tons of identified soda ash resources could be obtained from the 62 billion tons of bedded trona 2/ and the 52 billion tons of interbedded or intermixed trona and halite that are in beds more than 4 feet thick. About 37 billion tons of reserve base soda ash could be obtained from the 40 billion tons of halite-free trona and the 27 billion tons of inter-bedded or intermixed trona and halite that are in beds more than 6 feet thick. Two potential sources of soda ash, nahcolite (sodium bicarbonate) and dawsonite (sodium-aluminum carbonate), are associated with oil shale in northwest Colorado. Identified resources of 32 billion tons of nahcolite and 19 billion tons of dawsonite (equivalent to 27 billion tons of sodium carbonate resources) are available as a byproduct of oil shale processing.

There are at least 62 identified natural sodium carbonate deposits in the world, some of which have been quantified. The countries and number of deposits include: Australia (1), Bolivia (2), Botswana (1), Brazil (1), Canada (3), Chad (1), China (9), Egypt (1), Ethiopia (1), India (2), Kenya (3), Mexico (1), Namibia (1), Niger (1), Pakistan (1), the Republic of South Africa (1), Tanzania (5), Turkey (1), Uganda (1), the U.S.S.R. (4), the United States (20), and Venezuela (1).

11. Substitutes: Caustic soda can be substituted for soda ash in certain uses. An alternate source of soda ash is nahcolite, but commercial development of oil shale mining with byproduct nahcolite and dawsonite recovery is uncertain.

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SODIUM SULFATE

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: The domestic production of natural sodium sulfate decreased in 1985 compared with that of 1984. About 53% of the U.S. sodium sulfate production was a byproduct from various chemical and rayon manufacturing plants. Total production of sodium sulfate was valued at about $75 million in 1985. Three producers of natural sodium sulfate operated a total of four plants in California, Texas, and Utah. The major end uses of sodium sulfate were detergents, 47%; pulp and paper, 36%; and glass and miscellaneous, 17%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Natural	608	1/864	423	435	375
Synthetic 2/	503	-	432	437	425
Imports for consumption	275	394	343	265	200
Exports	124	111	91	76	100
Consumption, apparent (natural and synthetic)	1,229	1,183	1,089	1,050	900
Price: Quoted, sodium sulfate-100% Na_2SO_4, bulk, f.o.b. works, East, dollars per ton	78.00	103.00	103.00	113.00	114
Average sales value (natural source), f.o.b. mine or plant, dollars per ton	71.03	83.30	93.30	92.16	94
Stocks, producer, yearend, natural	66	30	48	59	59
Employment, wells and plants	500	450	450	420	420
Net import reliance 3/ as a percent of apparent consumption	10	27	21	17	11

3. Recycling: There was some recycling of sodium sulfate by consumers, particularly in the pulp and paper industry, but no recycling by sodium sulfate producers.

4. Import Sources (1981-84): Canada 90%, Belgium 3%, Mexico 3%, Other 4%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Crude (salt cake)	421.42	Free	Free	Free
Anhydrous	421.44	34¢/l.t.	33¢/l.t.	$3/l.t.
Crystallized (Glauber's salt)	421.46	2.6% ad val.	2.5% ad val.	4% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign)--natural only.

7. Government Stockpile: None.

e/ Estimated. NA Not available.
1/ Includes synthetic sodium sulfate because natural sodium sulfate production data were withheld in 1982 to avoid disclosing company proprietary data.
2/ Source: U.S. Bureau of the Census.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ See page 182 for definitions.

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8. Events, Trends, and Issues: Despite the recent economic recovery in the domestic pulp and paper industry, consumption of low-purity sodium sulfate, known as salt cake, continued to decline, primarily because of substitution of less expensive emulsified sulfur and caustic soda. Although demand in 1985 for high-grade sodium sulfate was weak, it had doubled since the mid-1970's. Apparent consumption of total sodium sulfate in 1984 was at the lowest level in more than 30 years. The estimated 1985 level was even lower than that of 1984, about 900,000 tons.

A byproduct sodium sulfate plant in Baltimore, MD, closed at midyear because of weak demand for chromium chemicals, the primary products manufactured at that facility, and environmental problems. The plant had an annual capacity of 60,000 tons of byproduct sodium sulfate.

A 45,000-ton-per-year sodium sulfate dredging operation at Metiskow, Alberta, Canada, was sold because of production problems that affected profitability. The former owner had required low-grade salt cake for its pulp mills but had sold its own salt cake product to the detergent industry to increase revenues. The company indicated that it had become more economical to rely on independent suppliers for its pulp mills' salt cake requirements.

It is estimated that in 1986 domestic mine production of sodium sulfate will be 400,000 tons and U.S. apparent consumption will be 1 million tons. From a 1983 base, demand for sodium sulfate is expected to increase at an average annual rate of about 1.4% through 1990.

9. World Mine Production and Reserve Base: (Natural sources)

	Mine production		Reserve Base 4/
	1984	1985 e/	
United States	435	375	1,500,000
Argentina	50	50	NA
Canada	427	400	300,000
Iran	13	10	NA
Mexico	165	170	250,000
Spain	353	350	300,000
Turkey	61	60	NA
Other Market Economy Countries	3	5	250,000
U.S.S.R.	397	400	2,500,000
World Total	1,904	1,820	5,100,000

10. World Resources: Sodium sulfate resources are sufficient to last hundreds of years at the present rate of world consumption. In addition to the above countries, identified resources of sodium sulfate exist in Botswana, Egypt, Italy, Mongolia, Romania, and the Republic of South Africa.

11. Substitutes: In pulp and paper, emulsified sulfur and caustic soda can replace sodium sulfate. In detergents, a variety of products can substitute for sodium sulfate. In glassmaking, soda ash or calcium sulfate have been substituted for sodium sulfate with less than perfect results.

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STONE (CRUSHED) 1/

(Data in million short tons, unless noted)

1. Domestic Production and Use: Crushed stone valued at $4.2 billion was produced by 1,800 companies operating 3,800 quarries in 48 States. Leading States in order of production were Texas, Florida, Pennsylvania, Virginia and Georgia, which accounted for nearly 33% of the output. About 65% of this tonnage was used as construction aggregate, mostly for highway and road construction and maintenance; 12% was used for cement and lime manufacturing; 2% in agriculture; 1% for metallurgical process; 2% for a variety of industrial uses; and 18% for other uses. Of the crushed stone produced in 1985, about 72% was limestone and dolomite; 14% granite; 9% traprock; 2% sandstone; and the remaining 3% was shell, marl, volcanic cinder, slate, and other.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production	873	790	862	956	1,005
Imports for consumption	3	2	3	3	3
Exports	4	2	2	2	2
Consumption, apparent	872	790	863	957	1,006
Price, average value, dollars per ton	3.58	3.89	3.86	3.93	4.15
Stocks, yearend		Not available			
Employment, quarry and mill 2/	52,000	51,000	52,000	53,000	54,000
Net import reliance 3/ as a percent of apparent consumption			None		

3. Recycling: Asphalt-crushed stone road surfaces and, to a lesser extent, cement concrete surfaces were recycled on a limited but increasing basis in some States.

4. Import Sources (1981-84): Canada 84%, Bahamas 9%, Other 7%.

5. Tariff: Crushed stone rates will vary from free to 1.3% ad valorem for most favored nations and to 30% ad valorem from non-most favored nations in 1986 according to the type of stone and use. All crushed stone is scheduled to be imported free from most favored nations by January 1, 1987.

6. Depletion Allowance: (Domestic and Foreign) 14% for chemical and metallurgical uses; 5% if used for riprap, ballast, road material, rubble, concrete aggregate, and similar purposes.

7. Government Stockpile: None.

e/ Estimated. NA Not available.
1/ See also Stone (Dimension).
2/ Excluding office staff.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ See page 182 for definitions.

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8. Events, Trends, and Issues: Crushed stone output increased in 1985 by about 5%. It is estimated that 1986 domestic production and U.S. apparent consumption will be about 1 billion tons each. From a 1983 base, demand for crushed stone is expected to increase at an average annual rate of 2.4% through 1990, giving a probable forecast demand in 1990 of 1.1 billion tons.

The crushed stone industry continued to be concerned with safety regulations and environmental restrictions. Shortages in some urban and industrialized areas were expected to continue to increase due to local zoning regulations and land development alternatives. This was expected to continue to cause a relocation of crushed stone quarries from high population centers.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 4/
	1984	1985 e/	
United States	956	1,005	Adequate except for certain special types and local shortages.
Other Countries	NA	NA	

10. World Resources: Stone resources of the world are practically inexhaustible. High-purity limestone and dolomite suitable for chemical and metallurgical use are limited in many geographical areas. The largest resources of high-purity limestone and dolomite in the United States are in the central and eastern parts of the country.

11. Substitutes: Crushed stone substitutes for roadbuilding include sand and gravel and slag. Substitutes for aggregate include sand and gravel, slag, sintered or expanded clay or shale, and perlite or vermiculite.

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STONE (DIMENSION) 1/

(Data in thousand short tons and million dollars, unless noted)

1. Domestic Production and Use: Dimension stone totaling 1.30 million tons valued at $170 million was produced by 220 companies at 300 quarries in 38 States. It was used in construction of buildings, 42%; and monuments, 27%; the remainder was used as rubble, 13%; flagging, 4%; curbing, 4%; and other, 10%. Leading producing States were North Carolina, Georgia, and Indiana, which accounted for about 40% of the output. Of the total, 52% was granite, 21% was limestone, 12% was sandstone, 4% was slate, 3% was marble, and 8% was other.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, tonnage	1,331	1,089	1,090	1,157	1,299
value	150	138	148	155	170
Imports for consumption, value	133	170	195	232	302
Exports, value	21	19	21	26	18
Consumption, apparent, value	262	296	323	360	454
Price	Variable, depending on type of product				
Stocks, yearend	Not available				
Employment, quarry and mill 2/	3,300	3,200	3,000	3,000	3,000
Net import reliance 3/ as a percent of apparent consumption (based on value)	43	52	54	57	63
Granite only:					
Production	682	656	601	638	740
Imports for consumption	100	110	120	490	685
Exports	88	83	88	92	57
Consumption, apparent	694	708	648	1,053	1,368
Price	Variable, depending on type of product				
Stocks, yearend	Not available				
Employment, quarry and mill 2/	1,700	1,600	1,500	1,500	1,500
Net import reliance 3/ as a percent of apparent consumption (based on tonnage)	2	4	5	38	46

3. Recycling: Small amounts of dimension stone are recycled, principally by restorers of old stone work.

4. Import Sources (1981-84): (based on value) Dimension stone: Italy 69%, Canada 10%, Spain 3%, Other 18%, Granite only: Italy 66%, Canada 21%, Other 13%.

5. Tariff: Dimension stone tariffs will vary from free to 7.7% ad valorem for most favored nations in 1986 according to type, size, value, and degree of preparation. Ad valorem rates for most favored nations are scheduled to decrease a final time on 1/1/87.

e/ Estimated. NA Not available.
1/ See also Stone (Crushed).
2/ Excluding office staff.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ See page 182 for definitions.

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6. Depletion Allowance: (Domestic and Foreign) 14%; 5% if used for rubble and other nonbuilding purposes.

7. Government Stockpile: None.

8. Events, Trends, and Issues: Dimension stone imports increased significantly for the fifth successive year to a value of $302 million in 1985. Value of imports exceeded that of production for the fourth successive year. From a 1983 base, demand for dimension stone is expected to increase at an average annual rate of about 2% through 1990. It is estimated that in 1986 domestic production of dimension stone will be 1.3 million tons and U.S. apparent consumption will be valued at $450 million.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 4/
	1984	1985 e/	
United States	1,157	1,299	Adequate except for
Other countries	NA	NA	certain special types
World total	NA	NA	and local shortages.

10. World Resources: Dimension stone resources of the world are inexhaustible. Resources can be limited on a local level, or occasionally on a regional level, by the lack of a particular kind of stone or a lack of a given stone that is suitable for dimension purposes.

11. Substitutes: Substitutes for dimension stone include concrete, steel, aluminum, resin agglomerated stone and plastics.

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STRONTIUM

(Data in short tons of contained strontium, unless noted)

1. Domestic Production and Use: There has been no strontium mineral production in the United States since 1959. Celestite, which is the commercial strontium mineral, was imported primarily from Mexico in 1985. The Federal Republic of Germany, Spain, and Italy, in descending order, were the chief suppliers of strontium compounds. Only one U.S. company, located in Georgia, was a major producer of strontium compounds. Primary strontium compounds were used in the manufacture of glass for color television picture tube faceplates, 53%; pyrotechnics and signals, 14%; ferrite ceramic magnets, 11%; and other uses, 22%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, strontium minerals			None		
Imports for consumption:					
Strontium minerals	21,800	14,500	21,800	21,500	21,600
Strontium compounds	2,500	1,100	500	2,600	4,800
Exports (celestite and compounds)	3,000	300	1/NA	1/NA	1/NA
Shipments from Govt. stockpile excesses			None		
Consumption, apparent (celestite and compounds)	19,200	16,700	22,700	W	W
Price, average value of mineral imports at port of exportation, dollars per ton	64.51	62.19	74.42	87.87	80.00
Stocks, consumer, yearend (celestite only)	7,700	6,300	5,900	W	W
Net import reliance 2/ as a percent of apparent consumption	100	100	100	100	100

3. Recycling: None.

4. Import Sources (1981-84): Mexico 96%, Spain, 4%. Minerals only.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Compounds:				
Carbonate:				
Not precipitated	421.70	Free	Free	Free
Precipitated	421.72	4.4% ad val.	4.2% ad val.	25% ad val.
Nitrate	421.74	4.4% ad val.	4.2% ad val.	25% ad val.
Oxide	421.76	4.4% ad val.	4.2% ad val.	25% ad val.
Minerals:				
Celestite	421.82	Free	Free	Free
Other	421.84	3.9% ad val.	3.7% ad val.	25% ad val.
Other	421.86	3.9% ad val.	3.7% ad val.	25% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile:

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Celestite	-	5,903	5,903	-

e/ Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
1/ Export data are not available and are assumed to be zero for net import reliance and apparent consumption calculations.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ Short tons of celestite.
4/ See page 182 for definitions.

Prepared by J. E. Ferrell, telephone number (202) 634-1177.

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8. Events, Trends, and Issues: World production of strontium minerals increased slightly in 1985 compared with that of 1984. The United States, totally reliant on imports of strontium minerals, imported mainly from Mexico about 33% of the 1985 world production of celestite. The main Mexican supplier of celestite to the United States announced that the company was constructing a strontium carbonate plant with a capacity of 12,000 tons per year. This development could place the one remaining strontium carbonate manufacturer in the unenviable position of potentially competing with its primary ore supplier for the strontium carbonate market.

   In another development, a U.S. company purchased a 49% interest in a Mexico-based company that planned to construct a strontium carbonate plant with a capacity of 8,000 tons per year. The U.S. company indicated that it would market the strontium carbonate in the United States through its sales network.

   From a 1983 base, demand for strontium is expected to increase at an average annual rate of 1.6% through 1990. It is estimated that in 1986 there will be no domestic production of strontium minerals.

9. World Mine Production and Reserve Base:

	Mine Production 3/		Reserve Base 4/
	1984	1985 e/	
United States	-	-	1,500,000
Algeria	6,000	6,000	
Argentina	660	660	
Iran	5,100	5,100	
Italy	3,500	3,500	
Madagascar	-	35	
Mexico	44,000	42,000	Other:
Pakistan	170	600	11,700,000
Spain	37,500	40,000	
Turkey	38,600	40,000	
United Kingdom	13,200	13,000	
China	NA	NA	
U.S.S.R.	NA	NA	
World Total (may be rounded)	148,730	151,000	13,200,000

10. World Resources: Resources in the United States are several times the reserve base. World resources, although not thoroughly evaluated, are believed to exceed 1 billion tons.

11. Substitutes: Although it is possible to substitute for strontium in some of its applications, to do so would adversely affect performance and/or cost. For example, barium could replace strontium in color television tube glass only after extensive circuit redesign to reduce operating voltages that produce harmful secondary X-rays. Barium replacement of strontium in ferrite ceramic permanent magnets would decrease the maximum energy and temperature characteristics of the magnet. Substituting for strontium in pyrotechnics would be impractical because the desired brilliance and visibility are imparted only by strontium and its compounds.

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SULFUR

(Data in thousand metric tons of sulfur, unless noted)

1. Domestic Production and Use: In 1985, sulfur was produced at 189 operations in 32 States, Puerto Rico, and the Virgin Islands for a total shipment value of $1.17 billion. Texas and Louisiana accounted for 61% of production. Ten companies with 77 operations accounted for 77% of production. Frasch sulfur was produced in Texas and Louisiana by four companies operating five mines accounting for 44% of domestic production in all forms. Recovered elemental sulfur was produced as a coproduct at petroleum refineries, natural gas operations, and coking plants in 26 States, Puerto Rico, and the Virgin Islands by 54 companies with 153 individual plants. Sulfur was also produced in the form of sulfuric acid, pyrites, hydrogen sulfide, and sulfur dioxide in 17 States by 12 companies with 31 operations. Sulfur shipped for domestic consumption was obtained mainly from domestic sources: Recovered, 40%; Frasch, 33%; and combined coproduct sulfuric acid, pyrites, hydrogen sulfide, and sulfur dioxide, 10%. The remaining 17% of the sulfur was obtained by imports of Frasch and recovered sulfur. About 85% of the sulfur was converted to sulfuric acid prior to end use. Agricultural chemicals (fertilizers) accounted for 67% of sulfur demand. Organic chemicals, inorganic chemicals, and other chemical products accounted for 9%, petroleum refining 7%, and metal mining 2% of the sulfur demand. Other uses, 15%, were widespread, as most products produced by industry require sulfur in one form or another during some stage of their manufacture.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Frasch	6,348	4,210	3,202	4,193	5,000
Recovered elemental	4,259	4,404	4,955	5,214	5,150
Other forms	1,538	1,173	1,133	1,245	1,200
Total	12,145	9,787	9,290	10,652	11,350
Shipments, all forms	11,655	9,115	10,285	11,456	11,200
Imports for consumption, Frasch and recovered	2,522	1,905	1,695	2,557	2,250
Exports, Frasch and recovered	1,392	961	992	1,334	1,450
Consumption, apparent, all forms 1/	12,785	10,059	10,988	12,679	12,000
Price, reported average value, dollars per ton of elemental sulfur, f.o.b. mine/plant	111.48	108.27	87.24	94.31	104.68
Stocks, producer, yearend	3,634	4,202	3,218	2,434	2,584
Employment, mine/plant e/	4,000	3,700	3,700	3,500	3,400
Net import reliance 2/ as a percent of apparent consumption	5	4	15	16	5

3. Recycling: About 800,000 tons, sulfur content, of spent acid was reclaimed from petroleum refining and chemical processes.

4. Import Sources (1981-84): Canada, 66.6%; Mexico, 33.1%; Other, less than 1%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Sulfur (crude)	415.4500	Free	Free	Free

6. Depletion Allowance: 22% (Domestic), 22% (Foreign).

7. Government Stockpile: None.

e/ Estimated.
1/ Measured by shipments, plus imports, minus exports.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 182 for definitions.

Prepared by D. E. Morse, telephone number (202) 634-1190.

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8. Events, Trends, and Issues: World sulfur production increased by over 2 million tons in 1985. Nevertheless, world sulfur demand continued to surpass output, requiring a drawdown of world stocks by nearly 2 million tons during the year, compared with stock withdrawals of 3 and 4 million tons in 1983 and 1984, respectively. Sulfur inventories in western Canada were reduced to less than 10 million tons from a peak level of over 21 million tons in 1978. At the current rate of removal, world sulfur inventories could be exhausted near the end of the decade, which may result in severe shortages and rapidly escalating prices. Nearly two-thirds of the elemental sulfur produced in the world on an annual basis is produced as a byproduct of either petroleum refining or natural gas processing so that the quantity of sulfur supplied from these sources is dependent on the demand for fuels, not on the demand for sulfur.

Despite a decrease in demand of about 700,000 tons, and an increase in output of 700,000 tons, U.S. sulfur imports exceeded exports by 800,000 tons in 1985. One Frasch mine in Texas was closed during the year, the sixth mine closure in the past 4 years. The domestic fertilizer industry, which accounts for nearly two-thirds of U.S. sulfur demand, supplies not only the U.S. farmer but also is the dominant supplier of fertilizers to world markets. About one-half of the sulfur consumed by domestic fertilizer manufacturers in 1985 went into the production of exported chemical fertilizers. Additionally, nearly one-third of the feed grains produced by U.S. farmers was also exported. As a result, approximately 40% of the sulfur consumed in the United States went ultimately into exported products. From a 1983 base, demand for sulfur is expected to increase at an average annual rate of 3.2% through 1990. If, however, the U.S. fertilizer manufacturers and farmers are not able to compete successfully in the export markets, domestic sulfur demand could decrease substantially. It is estimated that in 1986 domestic sulfur production will be 11.3 million tons and U.S. apparent consumption will be 12.2 million tons.

9. World Mine Production and Reserve Base:

	Production - All Forms		Reserve Base 3/
	1984	1985 e/	
United States	10,652	11,350	175,000
Canada	6,609	6,750	300,000
France	1,900	1,800	20,000
Germany, Federal Republic of	1,490	1,600	30,000
Italy	490	500	15,000
Japan	2,572	2,700	10,000
Mexico	1,925	2,000	100,000
Spain	1,230	1,250	30,000
Near East	1,695	1,900	500,000
Other Market Economy Countries	4,184	4,500	300,000
Centrally Planned Economies	19,137	19,750	1,250,000
World Total (may be rounded)	51,884	54,000	2,700,000

10. World Resources: Resources of elemental sulfur in evaporite and volcanic deposits and sulfur associated with natural gas, petroleum, tar sands, and metal sulfides amount to about 5 billion tons. The sulfur in gypsum and anhydrite is almost limitless and some 600 billion tons are contained in coal, oil shale, and shale rich in organic matter, but low-cost methods have not been developed to recover sulfur from these sources. The domestic resource is about one-fifth of the world total.

11. Substitutes: There are no adequate substitutes for sulfur at present or anticipated price levels; some acids, in certain applications, may be substituted for sulfuric acid.

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TALC AND PYROPHYLLITE

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: There were about 30 talc producing mines in 10 States in 1985. Montana, Texas, Vermont, and New York in order of volume, produced, together, 84% of the yearly total. Ground talc was consumed in ceramics, 37%; paints, 19%; paper, 10%; roofing, 9%; plastics, 7%; cosmetics, 5%; rubber, 3%; insecticides, 1%; and other, 9%. Total pyrophyllite production, 7% of total talc plus pyrophyllite production and all in California and North Carolina, remained static in 1985. Consumption was mainly in ceramics, 35%; refractories, 25%; insecticides, 17%; roofing, 7%; and other 16%. The talc and pyrophyllite sold was valued at $24.2 million.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, mine	1,343	1,135	1,066	1,170	1,227
Sold by producers	1,221	1,025	1,163	1,212	1,250
Imports for consumption	27	27	44	45	34
Exports	311	232	218	256	282
Shipments from Govt. stockpile excesses			N O N E		
Consumption, apparent	937	820	989	1,009	1,079
Price: Crude or ground			$19 to $300 per ton		
Stocks, producer, yearend	291	401	304	250	50
Employment: Mine and mill	920	880	800	800	800
Net import reliance 1/ as a percent of consumption			N e t e x p o r t e r		

3. Recycling: Insignificant.

4. Import Sources (1981-84): Canada 43%, Italy 26%, Republic of Korea 6%, Other 25%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Crude, not ground	523.31	0.02¢/lb	Free	0.25¢/lb
Ground, washed, powdered	523.33	3.3% ad val.	2.4% ad val.	35.0% ad val.
Cut or sawed	523.35	Free		1¢/lb
Other, n.s.p.f.	523.37	4.8% ad val.	Free	35.0% ad val.

6. Depletion Allowance: Block steatite talc--22% (Domestic), 14% (Foreign).
Other--14% (Domestic), 14% (Foreign).

7. Government Stockpile: On July 8, 1985, the Administration announced that the President had proposed new National Defense Stockpile goals. By December 1, the proposal was still being considered by Congress.

Stockpile Status--9-30-85
(Short tons)

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Talc, block and lump	28	1,081	63	0
Talc, ground	0	1,089	0	0

e/ Estimated.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ See page 182 for definitions.

Prepared by R. A. Clifton, telephone number (202) 634-1206.

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8. Events, Trends, and Issues: U.S. mine production of talc-group minerals increased 10% compared with that of 1984. Apparent consumption of talc minerals in the United States was 10% higher than in 1984. From a 1983 base, demand for talc and related minerals is expected to increase at an average annual rate of about 4.5% through 1990. It is estimated that in 1986 domestic mine production of talc will be 1.4 million tons and U.S. apparent consumption will be 1.2 million tons.

   U.S. exports of talc minerals continued their growth as the tonnage exported in 1985 was 10% above that of 1984 and the highest since 1981.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 2/
	1984	1985 e/	
United States	1,170	1,227	600,000
Finland	342	360	40,000
France	320	340	40,000
Italy	165	160	40,000
Japan	1,666	1,700	220,000
Other Market Economy Countries	2,304	2,400	150,000
Centrally Planned Economies	2,000	2,200	180,000
World Total (may be rounded)	7,967	8,400	1,270,000

10. World Resources: The United States is self-sufficient in most grades of talc and related minerals. Domestic and world resources are estimated to be approximately 5 times the quantity of reserves.

11. Substitutes: In the ceramics market talc and pyrophyllite compete with each other as well as kaolin, fuller's earth, other inorganic fillers, and feldspar. Phosphate-bonded talc is a thoroughly acceptable substitute for block steatite talc; potential alternative materials are talc bonded with magnesium oxychloride, and either phosphate-bonded or hot-pressed synthetic mica. Talc, mica, and other minerals compete for plastic (especially polypropylene) filling and reinforcing roles.

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TANTALUM

(Data in thousand pounds of tantalum content, unless noted)

1. Domestic Production and Use: There has been no significant domestic tantalum mining industry since 1959, the exception being small unreported quantities of tantalum-bearing concentrates produced in 1980-82. Most metal, alloys, and compounds were produced by seven companies with eight plants; tantalum units were obtained from imported concentrates and tin slags, and from both foreign and domestic scrap. Total estimated value of domestic shipments of metal, alloys, and compounds was about $190 million. Consumption in the form of metal, powder, ingot, fabricated forms, and compounds and alloys had the following end uses: Electronic components, 63%; machinery, 19%; transportation, 13%; and other, 5%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, mine	Small	Small	-	-	-
Imports for consumption, concentrate, tin slags, and other e/1/	1,580	1,087	W	W	NA
Exports, concentrate, metal, alloys, waste, and scrap e/	222	340	262	383	375
Shipments from Govt. stockpile excesses	-	2/(33)	-	-	2/(254)
Consumption: Reported, raw material	1,269	e/800	e/900	e/1,300	NA
Apparent	1,262	1,060	1,181	1,680	1,200
Price, tantalite, dollars per pound 3/	81.50	40.91	25.06	30.66	27.00
Stocks, industry, processor, yearend	3,452	e/3,195	W	W	NA
Employment, processor e/	550	500	500	500	500
Net import reliance 4/ as a percent of apparent consumption	92	92	97	92	92

3. Recycling: Combined prompt industrial and obsolete scrap consumed was about 10% of raw materials consumed. Generation of new scrap was estimated to be over 250,000 pounds, most of which was consumed by processors.

4. Import Sources (1981-84): Thailand 41%, Brazil 10%, Malaysia 8%, Australia 8%, Other 33%. Starting at yearend 1982, imports from Canada were negligible.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Potassium fluotantalate	420.3620	3.2% ad val.	3.1% ad val.	25.0% ad val.
Tantalum concentrate	601.4200	Free	Free	Free
Synthetic tantalum/columbium concentrate	603.6700	Free	Free	30.0% ad val.
Tantalum, unwrought:				
Waste and scrap	629.0520	3.9% ad val.	3.7% ad val.	25.0% ad val.
Metal	629.0540	3.9% ad val.	3.7% ad val.	25.0% ad val.
Alloys	629.0700	5.2% ad val.	4.9% ad val.	25.0% ad val.
Tantalum, wrought	629.1000	5.9% ad val.	5.5% ad val.	45.0% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
1/ Metal, alloys, and synthetic concentrates; exclusive of waste and scrap.
2/ Data in parentheses denote stockpile acquisitions.
3/ Average value, contained tantalum pentoxide, 60% basis.
4/ Defined as imports - exports + adjustments for Government and industry stock changes.
5/ Excludes production of tantalum contained in tin slags reported by Tantalum International Study Center (TIC) as 828,000 pounds in 1984; data not available for 1985.
6/ See page 182 for definitions.
7/ Excludes Centrally Planned Economies.

Prepared by L. D. Cunningham, telephone number (202) 63[illegible]-1024.

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7. Government Stockpile: In addition to quantities shown below, the stockpile contains a negligible quantity in nonstockpile-grade metal and 1,152,000 pounds in nonstockpile-grade minerals. Tantalum minerals containing approximately 254,000 pounds of tantalum, contracted for in late 1983 and early 1984 by the General Services Administration, were delivered and recorded as tantalum stockpile inventory.

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Carbide powder	-	29	-	-
Metal	-	201	-	-
Minerals	8,400	1,686	-	-

8. Events, Trends, and Issues: Demand for tantalum dropped significantly from the 1984 level. Estimated factory sales of tantalum capacitors were down by over 20%, reflecting a downturn in the electronics industry. Imports for consumption of tantalum concentrates declined an estimated 60%. The published spot price for tantalum concentrates which began the year at about $31 per pound of contained pentoxide was down to $27 by midyear and was quoted in the fourth quarter at around $22, the lowest level since first quarter 1983. Published price quotations for tantalum mill products and powders were down by about 10% and 20%, respectively. In midyear 1985, Thailand's major tantalum producer agreed to supply tantalum-bearing tin slags to a Thai company for use at its tantalum processing facility under construction in Phuket, Thailand.

From a 1983 base, demand for tantalum is expected to increase at an average annual rate of about 3% through 1990. It is estimated that in 1986 domestic mine production of tantalum will be zero and U.S. apparent consumption will be 1.3 million pounds.

There are no known uncontrollable health hazards connected with production or fabrication of tantalum metals and compounds. Fumes, gases, dust, and low-level radiation generated by extraction plants can be controlled by modern technology.

9. World Mine Production and Reserve Base:

	Mine Production e/5/		Reserve Base 6/
	1984	1985	
United States	-	-	Negligible
Australia	150	180	20,000
Brazil	175	150	3,000
Canada	-	-	5,000
Malaysia	8	10	4,000
Nigeria	14	10	10,000
Thailand	242	250	20,000
Zaire	31	30	10,000
Other Market Economy Countries	83	80	4,000
Centrally Planned Economies	NA	NA	NA
World Total 7/	703	710	76,000

10. World Resources: Most of the world's resources of tantalum occur outside the United States. On a worldwide basis, identified resources of tantalum are considered adequate to meet projected needs. These resources are largely located in Australia, Brazil, Canada, Egypt, Malaysia, Nigeria, Thailand, and Zaire. The United States has about 3.4 million pounds of tantalum resources located in identified deposits, which were considered uneconomic at 1985 prices.

11. Substitutes: The following materials can be substituted for tantalum, but usually with less effectiveness: Columbium in superalloys and carbides; aluminum and ceramics in electronic capacitors; silicon, germanium, and selenium in electrical rectifiers; glass, titanium, zirconium, columbium, and platinum in corrosion-resistant equipment; and tungsten, rhenium, molybdenum, iridium, hafnium, and columbium in high-temperature applications.

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TELLURIUM

(Data in metric tons of tellurium content, unless noted)

1. Domestic Production and Use: Tellurium was recovered as a byproduct from anode slimes generated in the electrolytic refining of copper. One copper refinery located in Texas accounted for all domestic production of tellurium. Based on the average annual price for refined metal, consumption was valued at $2.7 million. Tellurium's primary use was as an alloying material in the production of free-machining steels. It was also used as a minor additive in copper and lead alloys and malleable cast iron, as an accelerator in rubber compounding, and as a semiconductor in thermoelectric, thermal imaging, and photoelectric applications. Consumption by major use was estimated as follows: Iron and steel products, 45%; nonferrous metals, 21%; chemicals, 21%; and other, 13%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, refinery	W	W	W	W	W
Imports for consumption	38	17	12	35	30
Exports		Not available			
Consumption, apparent	85	46	57	107	110
Price, dollars per pound, 99.7% min. 1/	14.00	10.00	9.00	11.00-11.50	11.00-11.50
Stocks, producer, refined, yearend	W	W	W	W	W
Employment		Not available			
Net import reliance 2/ as a percent of apparent consumption	W	W	W	W	W

3. Recycling: Insignificant.

4. Import Sources (1981-84): Canada 59%, United Kingdom 14%; Japan 6%, Other 21%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Metals	632.48	0.5% ad val.	Free	25.0% ad val.
Compounds	421.90	3.9% ad val.	3.7% ad val.	25.0% ad val.

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
1/ The published list price of tellurium was suspended Jan. 5, 1981. Prices are yearend prices quoted by one producer.
2/ Defined as imports - exports + adjustments for Government and industry stocks changes.
3/ See page 182 for definitions.
4/ Excluding production in the United States, Other Market Economy Countries, and Centrally Planned Economies.

Prepared by N. L. Jensen, telephone number (202) 634-1063.

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8. Events, Trends, and Issues: Due to the continued low level of domestic copper production, U.S. production of tellurium in 1985 was essentially the same as in 1984. Imports decreased by 15% while apparent consumption increased by about 3%. The increase was met from domestic stocks. The increase in demand for tellurium was attributed to the increase in demand for free-machining steels, primarily in the automobile industry. The one domestic producer quoted prices at $11.00-11.50 per pound for commercial-grade metal. From a 1983 base, demand for tellurium is expected to increase at an average annual rate of about 4.2% through 1990. It is estimated that in 1986 U.S. apparent consumption will be 115 metric tons.

9. World Refinery Production and Reserve Base:

	Plant production		Reserve Base 3/
	1984	1985 e/	
United States	W	W	6,000
Canada	15	15	2,000
Japan	63	70	-
Peru	14	15	2,000
Other Market Economy Countries	NA	NA	18,000
Centrally Planned Economies	NA	NA	6,000
World Total	4/92	4/100	34,000

10. World Resources: In addition to the above large reserve base of byproduct tellurium contained in identified copper deposits of economic grade, several other sources of byproduct metal exist. The reserve base of lead ore contains about one-fourth the quantity of tellurium occurring in economic copper deposits; however, at present very little lead is refined by the electrolytic method which allows tellurium recovery. Relatively small quantities of tellurium can be recovered from gold telluride ores. Resources of copper and other metals that are undeveloped, of uneconomic grade, or as yet undiscovered, contain several times the quantity of tellurium in identified economic copper deposits. Although coal deposits contain an estimated average of 0.015 part per million tellurium, or a total content about four times that of economic copper deposits, recovery of tellurium from coal appears unlikely in the foreseeable future.

11. Substitutes: The chief materials which can substitute for tellurium include selenium, bismuth, and lead in metallurgical applications, selenium and sulfur in rubber compounding applications, and selenium and germanium in electronic applications.

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THALLIUM

(Data in pounds of thallium content, unless noted)

1. **Domestic Production and Use:** Thallium is a byproduct recovered from flue dusts and residues collected in the smelting of copper, zinc, and lead ores. Although thallium was contained in ores mined in the United States, thallium metal was not recovered domestically in 1985. It was marketed as thallium compounds, or as metal in the form of sticks, ingots, or wire. The electronics industry consumed about 60% to 70% of the thallium used in 1985. The balance was used principally in pharmaceuticals, alloys, and glass manufacturing.

2. **Salient Statistics--United States:**

	1981	1982	1983	1984	1985 e/
Production, refinery	W	-	-	-	-
Imports for consumption 1/	755	2,541	2,799	2,535	2,700
Exports	Not available				
Consumption e/	2,500	2,500	2,800	2,500	2,700
Price, metal, dollars per pound 2/	7.50	35-45	35-45	35	35
Stocks, producer, yearend	W	W	W	W	W
Employment e/	5	-	-	-	-
Net import reliance 3/ as a percent of apparent consumption	W	100	100	100	100

3. **Recycling:** Insignificant.

4. **Import Sources (1981-84):** Belgium-Luxembourg 49%, Federal Republic of Germany 33%, Japan 8%, Norway 8%, Other 2%.

5. **Tariff:**

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Unwrought metal and waste and scrap	632.50	0.6% ad val.	Free	25% ad val.
Compounds	422.00	3.9% ad val.	3.7% ad val.	25% ad val.

6. **Depletion Allowance:** 14% (Domestic), 14% (Foreign).

7. **Government Stockpile:** None.

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
1/ Includes thallium contained in compounds.
2/ In 1981, domestic producer price. In 1982-85, estimated price of imported metal.
3/ Defined as imports - exports + adjustments for Government and industry stock changes.
4/ Based on the estimated thallium content of zinc ores.
5/ See page 182 for definitions.

Prepared by P. A. Plunkert, telephone number (202) 634-1083.

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8. Events, Trends, and Issues: As a result of the discontinuance of domestic production of thallium, the United States met its domestic requirements from imports and withdrawals from stocks. From a 1983 base, demand for thallium is expected to show no growth through 1990. It is estimated that in 1986 U.S. consumption of thallium will be 2,800 pounds.

   Thallium is a toxic material and is controlled to prevent a threat to the environment or labor force.

9. World Mine Production and Reserve Base: 4/

	Mine Production e/		Reserve Base 5/
	1984	1985	
United States	1,000	1,000	260,000
Other Countries	30,000	29,000	1,160,000
World Total	31,000	30,000	1,420,000

10. World Resources: World resources of thallium contained in zinc resources are about 36 million pounds, most of which are in Europe, Canada, and the United States. An additional 1.4 billion pounds are contained in the world's identified resources of coal.

11. Substitutes: While other light-sensitive materials can be substituted for thallium and its compounds in specific electronic applications, ample supplies of thallium discourage development of substitute and alternate materials.

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THORIUM 1/

(Data in metric tons of thorium oxide (ThO_2) content, unless noted)

1. Domestic Production and Use: Thorium is a byproduct of processing monazite, an ore mineral of the lanthanides and yttrium. Monazite was recovered domestically as a byproduct of mining heavy minerals sands for titanium and zirconium minerals. Thorium-bearing monazite was mined in the United States by one company in Florida for its lanthanide and yttrium contents. Thorium products used and produced by the domestic industry came from imports and industry and Government stocks. A lanthanide and yttrium separation plant in Texas produced thorium nitrate from an intermediate compound produced in France from Australian monazite. Thorium-containing residues and compounds, resulting from the processing of monazite and its concentrates for lanthanides, were stockpiled by processors in Tennessee and Texas. About 18 companies processed or fabricated thorium into various forms, including nuclear fuel. Thorium was used as a metal, oxide, nitrate, and chloride. Nonenergy uses were in incandescent lamp mantles, magnesium-thorium alloys, refactories, welding electrodes, and other uses. Thorium was also used as nuclear fuel in a commercial electric generating plant.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, refinery 2/	-	-	NA	NA	NA
Imports, metal, alloys and compounds e/3/	33	23	46	45	83
Exports, ores and concentrates e/	6	4	4	11	37
Shipments from Govt. stockpile excesses	3	-	-	-	2
Consumption, nonenergy applications e/	30	19	42	34	48
Price, yearend, dollars per kilogram, ThO_2:					
Nitrate, mantle-grade	9.50	10.60	10.60	10.10	10.10
Oxide, 99% grade	21.20	24.50	31.00	35.85	35.85
Stocks, industrial, yearend	Not available				
Employment, mine	None				
Net import reliance 4/ as a percent of apparent consumption	100	100	100	100	100

3. Recycling: None.

4. Import Sources (1981-84): France 81%, Canada 6%, Netherlands 6%, Other 7%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Ore	601.45	Free	Free	Free
Nitrate and oxide	422.10 & 422.12	9.0% ad val.	7.8% ad val.	35.0% ad val.
Unwrought metal, waste and scrap	632.52	4.4% ad val.	4.2% ad val.	25.0% ad val.
Alloys	632.68	3.6% ad val.	3.0% ad val.	25.0% ad val.

6. Depletion Allowance: Monazite, 22% on thorium content and 14% on rare-earth and yttrium content (Domestic), 14% (Foreign).

e/ Estimated. NA Not available.
1/ See also Rare-Earth Metals and Yttrium.
2/ All domestically consumed thorium was derived from imported materials.
3/ Includes estimated ThO_2 in imported gas mantles, thorium nitrate, thorium oxide, and other thorium compounds and metal. Monazite, containing 350 to 550 tons of thorium oxide, has been imported annually but has not recently been used to produce thorium products.
4/ Defined as imports - exports + adjustments for Government and industry stock changes.
5/ Thorium oxide equivalent.
6/ See page 182 for definitions.

Prepared by J. B. Hedrick, telephone number (202) 634-1082.

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7. Government Stockpile:

Stockpile Status-- 9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Thorium nitrate 5/	130	1,545	9	2

8. Events, Trends, and Issues: From a 1983 base, demand for thorium is expected to increase at an average annual rate of about 3% through 1990, due primarily to the expected increased use in refractory applications such as a heat-sink layer in nuclear reactors to contain reactor core meltdowns, and in high-temperature molds for investment casting. The quantity of thorium consumed for nuclear energy has been small when compared with other fuels. It is estimated that in 1986 U.S. apparent consumption will be 40 tons (ThO_2 equivalent), which would be met entirely from imports and existing industry and Government stocks.

The principal environmental concern in mining monazite-bearing placers along beaches and rivers was the possible conflict with urban and recreational land uses and damage to undeveloped areas. Land reclamation was practiced successfully at operations in Australia and the United States. Public concern and foreign and domestic regulations on handling and storing radioactive thorium materials have limited their use.

9. World Refinery Production and Reserve Base:

	Refinery Production		Reserve Base 6/
	1984	1985	
United States	NA	NA	220,000
Australia	NA	NA	25,000
Brazil	NA	NA	9,000
Canada	NA	NA	253,000
France	NA	NA	-
India	NA	NA	386,000
Malaysia	NA	NA	5,000
Norway	NA	NA	183,000
Other Market Economy Countries	NA	NA	117,000
Centrally Planned Economies	NA	NA	50,000
World Total (rounded)	NA	NA	1,250,000

10. World Resources: Large deposits of thorium occur in the United States in beach and stream placers, veins, and carbonatites. In these deposits there are thorium resources of more than 500,000 tons ThO_2. Disseminated deposits in various other alkaline igneous rocks contain additional resources of more than 2 million tons ThO_2. Large thorium resources are also found in Canada, India, Greenland, Brazil, the Republic of South Africa, and Australia.

11. Substitutes: No satisfactory alternate materials are suitable for major nonenergy uses of thorium, although research to develop non-radioactive substitutes was reported.

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TIN

(Data in metric tons of tin content, unless noted)

1. Domestic Production and Use: In 1985 small quantities of tin concentrates were produced from placer deposits in Alaska. The only U.S. tin smelter, at Texas City, TX, produced about 3,000 tons of tin from imported and domestic tin concentrates, residues, and other secondary tin-bearing materials. About one-fourth of the tin consumed in the United States was derived from secondary material at 5 detinning plants and 196 secondary nonferrous metal processing plants located principally in the East. Twenty-five firms consumed about 60% of the primary tin. The major uses were in cans and containers, 20%; electrical, 19%; construction, 14%; transportation, 14%; and other, 33%. The estimated value of consumption in 1985 was $600 million based on the New York composite price.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Mine		Negligible			
Smelter e/	2,000	3,500	2,500	4,000	3,000
Secondary (old scrap)	10,370	9,582	10,766	11,141	11,000
Imports for consumption: Metal	45,874	27,939	34,048	41,224	33,000
Ore	232	1,961	969	3,272	2,500
Exports, ingots, pigs, and bars 1/	2,361	5,769	1,340	1,429	800
Shipments from Govt. stockpile excesses	5,920	4,172	2,865	2,397	3,005
Consumption, reported: Primary	40,229	33,019	34,301	37,819	38,000
Secondary	14,144	13,276	11,246	11,622	12,000
Consumption, apparent	54,457	40,258	49,231	57,215	50,200
Price, average, cents per pound:					
New York market	648	587	601	568	540
New York composite	733	654	655	624	596
London	650	581	589	557	542
Penang	638	587	591	565	542
Stocks, consumer and dealer, yearend	11,131	10,251	9,859	9,977	9,000
Employment, mine and primary smelter e/	300	250	200	200	200
Net import reliance 2/ as a percent of apparent consumption	77	68	73	74	72

3. Recycling: About 15,000 tons of tin, including tin alloys, was recycled in 1985. About 11,000 tons was from old scrap and 4,000 from new scrap.

4. Import Sources (1981-84): Thailand 25%, Malaysia 17%, Bolivia 16%, Indonesia 15%, Other 27%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Ore and concentrate	601.48	Free	Free	Free
Metal	622.02	Free	Free	Free
Waste and scrap	622.10	Free	Free	Free

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile:

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Pig tin	42,674	185,434	16,594	2,790

e/ Estimated.
1/ Exports (excluding reexports).
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 182 for definitions. Reserve base data revised to include new data developed by the Division of Minerals Availability, U.S. Bureau of Mines.
4/ Excluding U.S. production.

Prepared by J. F. Carlin, Jr., telephone number (202) 634-1073.

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8. Events, Trends, and Issues: The reported consumption of primary tin increased slightly from the 1984 level. From a 1983 base, demand for tin is expected to increase at an average annual rate of about 1% through 1990. It is estimated that in 1986 U.S. apparent consumption of tin will be 52,000 tons.

Throughout the year, the International Tin Council (ITC) continued imposition of export controls on member producer countries in an attempt to balance world tin supply and demand. In late October, the ITC exhausted available funds to buy tin to support the price. This event caused the London Metal Exchange (LME) to suspend tin trading. The ITC sought to obtain interim or longer-term financing, with no resolution of the crisis by November.

Tin prices did not fluctuate much throughout most of 1985, but weakened appreciably in late October when the ITC ceased its purchases of tin. There continued to be an estimated 80,000 ton worldwide excess of supply relative to demand, as demand increased slowly throughout the year.

Despite objection by producer countries, the General Services Administration (GSA) continued its daily fixed-price sales of Government stockpile tin until late October when they were suspended pending resolution of the ITC crisis. An informal verbal agreement was made to continue the memorandum of understanding between the United States and the Association of Southeast Asian Nations (in effect through yearend 1984) to attempt to limit GSA tin disposals to about 6,000 tons over a 2-year period. Through November 4, 3,005 tons were sold. GSA extended an agreement with two metal processing firms to upgrade certain ores to ferroalloys, for the duration of 1985 and 1986. To pay for the processing, GSA awarded these firms 2,650 tons of stockpile tin through November 4, 1985.

Tin was mined and smelted in such small quantities in the United States that environmental effects were almost nonexistent. In secondary detinning operations, tin-containing muds are generated as waste material. Waste water from the rinsing of detinned steel may contain small amounts of caustic, sodium nitrate and tin. Drosses and dusts from industrial centers evertually become sources of secondary tin.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 3/
	1984	1985 e/	
United States	Negligible	Negligible	40,000
Australia	9,300	9,000	180,000
Bolivia	21,100	19,000	140,000
Brazil	16,000	18,000	70,000
Burma	2,000	2,000	10,000
Indonesia	21,500	20,000	680,000
Malaysia	41,300	40,000	1,110,000
Nigeria	1,700	1,500	20,000
Thailand	21,900	20,000	270,000
United Kingdom	4,600	4,600	90,000
Zaire	3,000	3,000	20,000
Other Market Economy Countries	11,200	10,000	260,000
China	15,000	15,000	80,000
U.S.S.R.	36,000	35,000	80,000
Other Centrally Planned Economies	4,000	4,000	30,000
World Total (may be rounded)	4/209,000	4/201,000	3,000,000

10. World Resources: U.S. tin resources, located primarily in Alaska, are insignificant when compared with those of the rest of the world. World resources are located principally in southeastern Asia, Australia, Bolivia, Brazil, China, and the U.S.S.R. Sufficient resources are available to sustain present production rates well into the next century.

11. Substitutes: Aluminum, glass, paper, plastic, or tin-free steel substitute for tin in cans and containers; epoxy resins for solder; aluminum alloys, copper-base alloys, or plastics for bronze; lead-base bearing alloys or plastics for tin-containing bearing metals, and sodium for some tin chemicals.

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TITANIUM AND TITANIUM DIOXIDE 1/
(Data in short tons, unless noted)

1. Domestic Production and Use: Titanium sponge metal was produced by five firms, with production in Nevada, Ohio, Oregon, and Washington. Ingot was made by four sponge makers and by six other firms located in eight States. Twenty-three companies produced titanium mill products or castings, mainly in the east-central region. In 1985, about 63% of the titanium metal was used in jet engines, airframes, and space and missile applications, about 20% was used in the chemical processing industry, power generation, and in marine and ordnance applications, and 17% in steel and other alloys. The value of sponge metal consumed was about $180 million, assuming an average selling price of about $4.00 per pound.

Titanium dioxide (TiO_2) pigment was produced by 5 companies at 11 plants in 8 States. In 1985, uses of TiO_2 were in paints, varnishes, and lacquers, 52%; paper, 24%; plastics, 14%; rubber, 2%; ceramics, 1%; and other 7%. The value of TiO_2 consumed was about $1.3 billion.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Metal:					
Production	2/26,400	2/15,600	13,966	24,326	24,000
Imports for consumption, sponge	6,490	1,354	1,199	2,667	1,900
Exports, mainly scrap	9,644	8,096	7,830	7,333	11,000
Shipments from Govt. stockpile excesses 3/	-	-	-	(139)	(4,361)
Consumption of sponge metal, reported e/	31,599	17,328	16,072	24,713	22,000
Price, sponge, list, dollars per pound, yearend	7.65	5.55	5.55	5.55	5.55
Stocks, sponge, industry, yearend e/	3,720	3,350	3,136	3,147	4,600
Employment, reduction plants	2,200	1,500	1,500	1,800	1,800
Net import reliance 4/ sponge only as a percent of apparent consumption	W	W	9	9	E
Titanium Dioxide:					
Production	761,190	659,710	760,385	798,978	804,000
Imports for consumption	124,906	138,922	174,857	193,501	186,000
Exports	61,104	72,823	91,702	106,124	105,000
Consumption, apparent	806,040	741,065	853,008	880,287	904,000
Price, rutile, list, dollars per pound, yearend	0.75	0.75	0.75	0.75	0.78
Stocks, producer, yearend	102,189	86,933	77,465	83,533	65,000
Employment	4,600	4,400	4,200	4,400	4,400
Net import reliance 4/ as a percent of apparent consumption	6	11	11	9	11

3. Recycling: New scrap metal recycled was 15,000 tons in 1985. In addition, estimated use of scrap and ferrotitanium by the steel industry was 2,900 tons; by the aluminum industry, 500 tons; and in miscellaneous alloying uses, 300 tons. Old scrap reclaimed was about 100 to 400 tons. There was no known recycling of TiO_2.

4. Import Sources (1981-84): Sponge metal: Japan 91%, China 6%, U.S.S.R. 3%.
Titanium dioxide pigment: Federal Republic of Germany 23%, France 20%, Canada 14%, Spain 12%, Other 31%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Waste and scrap metal	629.12	8.6% ad val.	7.2% ad val.	25.0% ad val.
Unwrought metal	629.14	15.5% ad val.	15.0% ad val.	25.0% ad val.
Wrought metal	629.20	15.5% ad val.	15.0% ad val.	45.0% ad val.
Titanium dioxide	473.70	6.2% ad val.	6.0% ad val.	30.0% ad val.

6. Depletion Allowance: Not applicable.

e/ Estimated. W Withheld to avoid disclosing company proprietary data. E Net exports.
1/ See also Ilmenite and Rutile.
2/ Calculated sponge metal production = sponge consumption - sponge imports + sponge exports and adjustments for Government and industry stock changes.
3/ Figures in parentheses are acquisitions recorded as inventory.
4/ Defined as imports - exports + adjustments for Government and industry stock changes.

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7. Government Stockpile: The General Services Administration (GSA) stockpile inventory total shown below includes 4,500 tons of titanium sponge delivered in 1984 and 1985 under contracts awarded by GSA in October 1983. The stockpile also contains an additional 10,866 tons of nonstockpile-grade sponge metal.

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Stockpile grade	195,000	25,965	-	-

8. Events, Trends, and Issues: The domestic titanium sponge production rate decreased gradually in 1985, and was about 65% of capacity at yearend. A decrease in demand resulted mainly from leveling off of orders for commercial and military aircraft, and lower than expected requirements for other industrial uses.

A final dumping margin of 83.96% was found by the Department of Commerce on 75 tons of sponge imported from the U.S.S.R. between August 1, 1982, and July 31, 1983. Importers of that sponge were to be assessed antidumping duties of 83.96% of the price paid. Future imports of U.S.S.R. sponge were to be subject to a deposit equivalent to the antidumping margin, until publication of the findings for the next annual review period, August 1, 1983 to July 31, 1984.

A TiO_2 producer based in Finland purchased TiO_2 pigment-production facilities in Savannah, GA. Sales of titanium sponge metal reportedly were mostly in the range of $3.75 to $4.25 per pound. Sales prices of TiO_2 pigment increased in three steps and reached new high levels by yearend.

It is estimated that in 1986 U.S. production of titanium sponge will be 26,000 tons, apparent consumption of sponge will be 28,000 tons, production of TiO_2 pigment will be 815,000 tons, and apparent consumption of pigment will be 915,000 tons.

From a 1984 base, demand for titanium sponge is expected to increase at an average annual rate of about 5% through 1990. From a 1984 base, demand for TiO_2 is expected to increase at an average annual rate of about 1.5% through 1990.

Titanium dioxide pigment plant effluents consist mainly of sulfuric acid, ferrous sulfate, and ferric chloride. Disposal methods include neutralization, deep-well disposal, and barging out to sea.

9. Sponge Metal Production and Sponge and Pigment Capacity:

	Sponge Production		Capacity 1985	
	1984	1985 e/	Sponge	Pigment
United States 2/	24,326	24,000	33,500	894,000
Finland	-	-	-	88,000
France	-	-	-	182,000
Germany, Federal Republic of	-	-	-	353,000
Japan	16,938	23,000	38,000	250,000
United Kingdom	e/2,500	2,000	5,500	250,000
Other Market Economy Countries	-	-	-	589,000
China e/	2,000	2,000	3,000	22,000
U.S.S.R. e/	46,000	47,000	53,000	137,000
Other Centrally Planned Economies e/	-	-	-	84,000
World Total (may be rounded)	92,000	99,000	133,000	2,849,000

10. World Resources: The source of titanium for domestic sponge production was rutile. For pigment production the sources were ilmenite, slag, and rutile. The U.S.S.R. reportedly used a high-grade titaniferous slag for sponge metal production.

11. Substitutes: For aircraft and space use there is essentially no substitute for titanium. For industrial uses high-nickel steel, zirconium, and to a limited extent the superalloy metals may be substituted. There is no cost-effective substitute for TiO_2 pigment.

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TUNGSTEN

(Data in metric tons of tungsten content, unless noted)

1. Domestic Production and Use: In 1985, approximately 90% of the domestic tungsten concentrate production, valued at an estimated $8 million, came from three mines in California and Colorado. Two of these mining operations recovered metals other than tungsten. Estimated production, as measured by domestic mine shipments, decreased 6% during the year. End uses of tungsten were: Metalworking, mining, and construction machinery and equipment, 74%; electrical machinery and equipment, 8%; lamps and lighting, 7%; transportation, 6%; and other, 5%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, mine shipments	3,545	1,575	1,016	1,173	1,100
Imports for consumption, concentrate	5,331	3,528	2,861	5,807	4,800
Exports, concentrate	79	305	1	129	100
Shipments from Govt. stockpile excesses, concentrate	958	344	259	1,368	800
Consumption: Reported, concentrate	9,839	4,506	5,181	8,577	6,900
Apparent, concentrate, scrap, metal	10,317	6,050	6,478	10,164	8,500
Price, concentrate, dollars/mtu WO_3 1/, average:					
U.S. market	144	106	85	85	68
European market	142	107	81	87	71
Stocks, producer and consumer, yearend, concentrate	779	1,819	1,132	1,005	1,500
Employment, mine and mill	907	475	300	287	300
Net import reliance 2/ as a percent of apparent consumption	50	42	52	70	68

3. Recycling: During 1985, the quantity of purchased scrap represented about 1,600 tons.

4. Import Sources (1981-84): Canada 18%, China 17%, Bolivia 16%, Portugal 8%, Other 41%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Ore and concentrate	601.54	17¢/lb. W cont.	17¢/lb. W cont.	50¢/lb. W cont.
Ferrotungsten	606.48	6.2% ad val.	5.6% ad val.	35% ad val.
Unwrought lumps, grains, and powders	629.28	11.3% ad val.	10.5% ad val.	58.0% ad val.
Ammonium tungstate	417.40	10.4% ad val.	10.0% ad val.	49.5% ad val.
Tungsten carbide	422.40	11.0% ad val.	10.5% ad val.	55.5% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: The General Services Administration continued to offer excess tungsten concentrate for sale at a rate of 27 tons per month through September, after which all sales were discontinued. In addition to quantities shown below, the stockpile contains the following nonstockpile-grade materials (in tons): Ore and concentrate, 11,992; metal powder, 150; ferrotungsten, 537; and carbide powder, 51; authority for disposal of 575 tons of ore and concentrate was in effect as of September 30. The total quantity of nonstockpile-grade material disposals during the first 9 months was 559 tons.

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Ore and concentrate	25,152	24,653	24	47
Metal powder	726	711	-	-
Ferrotungsten	-	381	-	-
Carbide powder	907	871	-	-

e/ Estimated.
1/ A metric ton unit (mtu) of tungsten trioxide (WO_3) contains 7.93 kilograms of tungsten.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 182 for definitions.

Prepared by P. T. Stafford, telephone number (202) 634-1029.

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8. Events, Trends, and Issues: Estimated world production of tungsten in concentrate increased slightly and consumption decreased 6% in 1985 compared with that of 1984, as demand for tungsten in cemented carbides and mill products decreased, especially in the United States. The average U.S. monthly price of tungsten concentrate was $75/mtu WO_3 in January, $77 in April, and $68 in October.

It is estimated that in 1986 domestic mine production of tungsten will be 1,400 tons and U.S. apparent consumption will be 7,000 tons. From a 1983 base, U.S. demand for tungsten is expected to increase at an average annual rate of about 16% through 1990. As of the the end of November, three of the five major U.S. tungsten mines were temporarily closed because of relatively low prices. Mine capacity utilization, 22% in 1985, decreased slightly compared with that of 1984. However, because of a significant decline in imports of concentrate, the net import reliance of concentrate as a percent of apparent consumption decreased from 85% in 1984 to 82% in 1985.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 3/
	1984	1985 e/	
United States (mine shipments)	1,173	1,100	290,000
Australia	1,843	2,000	140,000
Austria	1,294	1,400	20,000
Bolivia	2,100	1,700	70,000
Brazil	998	1,200	20,000
Burma	1,096	1,100	15,000
Canada	3,690	3,000	670,000
France	796	800	20,000
Korea, Republic of	2,703	2,600	60,000
Portugal	1,493	1,400	40,000
Thailand	741	600	30,000
Other Market Economy Countries	3,362	4,500	260,000
China	13,500	13,500	1,230,000
U.S.S.R.	9,100	9,100	490,000
Other Centrally Planned Economies	1,050	1,100	105,000
World Total	44,939	45,100	3,460,000

10. World Resources: More than 90% of the world's estimated tungsten resources are located outside the United States, with about 50% located in China. Other areas with significant resource potential are in Australia, Austria, Burma, Canada, Malaysia, Mexico, North Korea, Portugal, Republic of Korea, southern Africa, South America, Thailand, Turkey, and the U.S.S.R.

11. Substitutes: Coatings, primarily aluminum oxide, titanium carbide, and titanium nitride, have improved the cutting and wear resistance of cemented tungsten carbide tool inserts. The use of coatings is expected to increase during the next few years. This extended wear capability of the inserts decreases the rate of replacement and, hence, the growth of tungsten consumption. Also, there will probably be a slow increase in the substitution of cemented tungsten carbide-based products by titanium carbide-based cutting tools, by ceramic cutting tools and wear parts, and by polycrystalline diamond.

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VANADIUM

(Data in thousand pounds of vanadium content, unless noted)

1. Domestic Production and Use: The U.S. vanadium industry consisted of 12 firms in 1985, but only 5 had active extraction operations. Raw materials included Idaho ferrophosphorus slags, Arkansas clay, petroleum residues, utility ash, spent catalysts, and imported iron slags. Five of the remaining seven firms restricted themselves to the conversion of vanadium pentoxide to alloys or primary chemicals. The chief use of vanadium was as an alloying agent for iron and steel. It was also important in the production of titanium alloys, and as a catalyst for production of sulfuric acid. About 150 plants throughout the United States reported consumption in 1985. Major end use distribution: Transportation, 41%; machinery, 26%; building and heavy construction, 13%; and other, 20%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production:					
Mine, recoverable basis	10,252	8,196	4,342	3,234	W
Mill, recovered basis 1/	12,736	9,734	4,866	5,240	W
Petroleum residues, recovered basis	3,800	3,026	1,786	3,326	5,000
Imports for consumption:					
Ores, slags, residues	4,870	2,224	115	1,266	600
Vanadium pentoxide, anhydride	669	238	754	297	160
Ferrovanadium	1,968	1,339	1,361	2,341	1,800
Exports:					
Ores	111	114	117	24	10
Vanadium pentoxide, anhydride	388	1,772	2,967	4,158	1,600
Other compounds	72	434	114	366	430
Ferrovanadium	608	457	1,085	656	730
Shipments from Govt. stockpile excesses 2/	-	-	-	(136)	(224)
Consumption: Reported	13,726	6,992	6,554	9,522	8,900
Apparent 3/	19,168	12,812	6,602	11,382	10,600
Price, average, dollars per pound V_2O_5	3.52	3.50	3.50	3.50	3.50
Stocks, producer and consumer, yearend	9,426	11,096	9,674	7,540	7,300
Employment, mine and mill	1,700	1,300	800	660	450
Net import reliance 4/ as a percent of apparent consumption	34	24	26	54	W

3. Recycling: Relatively small quantities of spent catalysts containing vanadium were reprocessed. Some tool steel scrap was recycled primarily for its vanadium content. Vanadium was also recycled as a minor component of scrap iron and steel alloys, which were used principally for their iron content.

4. Import Sources (1981-84): 5/ Republic of South Africa 38%, European Communities (EC) 25%, Canada 16%, Finland 6%, Other 15%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Ore and concentrate	601.60	Free	Free	Free
Slags and residues	603.65	Free	Free	Free
Ferrovanadium	606.50	4.5% ad val.	4.2% ad val.	25% ad val.
Unwrought metal; waste & scrap	632.58	3.9% ad val.	3.7% ad val.	25% ad val.
Ammonium vanadate	417.42	11.8% ad val.	11.2% ad val.	40% ad val.
Potassium vanadate	420.34	11.8% ad val.	11.2% ad val.	40% ad val.
Vanadium carbide	422.58	4.4% ad val.	4.2% ad val.	25% ad val.
Vanadium pentoxide, anhydride	422.60	16.0% ad val.	16.0% ad val.	40% ad val.
Vanadium compounds, other	422.62	16.0% ad val.	16.0% ad val.	40% ad val.

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
1/ Produced from domestic materials.
2/ Data in parentheses denote stockpile acquisitions.
3/ Includes processing losses from low-grade imports.
4/ Defined as imports - exports + adjustments for Government and industry stock changes.
5/ The EC and Canada produced vanadium alloys and chemicals solely from imported raw materials.
6/ See page 182 for definitions.
7/ Includes data for Bophuthatswana.
8/ Excludes U.S. production.

Prepared by P. H. Kuck, telephone number (202) 634-1021.

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6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: The stockpile purchase specifications and special instructions for vanadium were reviewed by an interagency committee in 1985 and were expected to be substantially changed. A joint industry and Government panel was formed to (1) assess the quality of the 2.2 million pounds gross weight of vanadium pentoxide acquired between 1947 and 1955, and (2) recommend other suitable forms of vanadium for future acquisition.

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months	Purchases, 9 Months
Vanadium pentoxide	15,400	1,442	-	-	224
Ferrovanadium	2,000	-	-	-	-

8. Events, Trends, and Issues: The restructuring of the U.S. vanadium industry continued throughout 1985. Coproduction of uranium and vanadium from sandstone ores was stopped on the Colorado Plateau by the lowest spot market prices for U_3O_8 in more than a decade. Only 43 uranium mines on the Plateau reported activity in 1985, compared with 198 mines in 1980. Many of the larger shippers in 1985 mined high-grade uraninite deposits with no significant vanadium mineralization. However, the marked decline in Plateau vanadium production was partially compensated by increased processing of petroleum residues and utility ash. It is estimated that in 1986 U.S. apparent consumption will be only 9 million pounds. Despite the bleak near-term outlook, consumption of vanadium should grow as demand for high-strength low-alloy steels and other high performance materials accelerates. From a 1981 base, demand for vanadium is expected to increase at an average annual rate of 2% through 1990.

In Canada, large-scale equipment was under development for extracting vanadium from fly ash generated by commercial oil sands plants. Overseas, a major South African producer of vanadium ores and slags completed construction in late 1984 of its second vanadium-bearing pig iron plant, but deferred commissioning because of weak demand for steel in international markets. Vanadiferous slag production facilities were also under construction in New Zealand.

Vanox, a new vanadium oxide product introduced in 1984, was being used or evaluated by at least eight U.S. steel companies as an alloying agent for tool steelmaking.

9. World Mine Production and Reserve Base:

	Production 1984	Production 1985 e/	Reserve Base 6/
United States	3,234	W	4,800,000
Australia	-	-	540,000
Finland	6,754	6,500	200,000
South Africa, Republic of 7/	27,596	30,000	17,200,000
Other Market Economy Countries	-	-	1,200,000
China	10,000	12,000	3,600,000
U.S.S.R.	21,000	22,000	9,000,000
World Total (may be rounded)	68,584	8/ 71,000	36,500,000

10. World Resources: World resources of vanadium exceed 140 billion pounds. Vanadium occurs in deposits of titaniferous magnetite, phosphate rock, and uraniferous sandstones and siltstones, where it constitutes less than 2% of the host rock. Significant amounts are also present in bauxite and carboniferous materials such as crude oil, coal, oil shale, and tar sands. Because vanadium is generally recovered as a byproduct or coproduct, demonstrated world resources of the element are not fully indicative of available supplies. While domestic resources are adequate to supply current domestic needs, a substantial part of U.S. demand is currently met by foreign material because of price advantages.

11. Substitutes: Steels containing various combinations of other alloying metals can be substituted for steels containing vanadium. Among the various metals that are interchangeable to some degree with vanadium are columbium, molybdenum, manganese, titanium, and tungsten. There is currently no acceptable substitute for vanadium in titanium alloys. Metallic platinum can replace vanadium compounds as a catalyst in some chemical processes.

January 1986

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VERMICULITE

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Value of production from three companies was $32 million in 1985. One company, operating an open pit in Montana and several pits in South Carolina, continued as the principal producer of vermiculite. Most of the vermiculite concentrate was shipped to 43 exfoliating plants in 28 States. The major uses for exfoliated vermiculite were agriculture, 22%; insulation, 26%; plaster and cement premixes, 31%; and lightweight concrete aggregate, 20%.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, mine 1/	320	316	282	315	310
Imports for consumption e/	27	21	24	26	25
Exports	31	22	19	e/20	20
Consumption, apparent, concentrate	316	315	287	321	315
Consumption, exfoliated	274	235	224	264	260
Price, average value, dollars per ton, f.o.b. mine	81.88	90.19	96.45	100.00	103.00
Stocks, producer, yearend		Not available			
Employment, mine and mill e/	330	300	300	300	300
Net import reliance 2/ as a percent of apparent consumption	E	E	2	2	2

3. Recycling: Insignificant.

4. Import Sources (1981-84): Republic of South Africa, 95%, Brazil, 5%.

5. Tariff:

Item	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Crude or processed	523.81	Free	Free	Free

6. Depletion Allowance: 14% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. E Net exporter. NA Not available.
1/ Concentrate sold or used by producers.
2/ Defined as imports - exports + adjustments for Government and industry stock changes.
3/ See page 182 for definitions.
4/ Excluding Centrally Planned Economies.

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8. Events, Trends, and Issues: From a 1983 base, demand for vermiculite is expected to increase at an average annual rate of about 2% through 1990. Transportation costs from the mine to exfoliation plants near the point of end use continued to limit the size of the market as well as vermiculite's competitive position with respect to other mineral commodities. The number of operating quarries is small, and the industry does not have any severe environmental problems. It is estimated that in 1986 domestic mine production of vermiculite concentrate and U.S. apparent consumption will each be about 330,000 tons.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 3/
	1984	1985 e/	
United States	315	310	100,000
South Africa, Republic of	192	190	80,000
Other Market Economy Countries	43	40	20,000
Centrally Planned Economies	NA	NA	NA
World Total 4/	550	540	200,000

10. World Resources: Marginal reserves of vermiculite, which occur in North Carolina, Texas, Wyoming, Colorado and Nevada, are estimated to be 2 to 3 million tons. Resources in other Market Economy Countries and in Centrally Planned Economies usually include material that has exfoliation characteristics considered to be inferior to U.S. and South African vermiculite. Total world resources are estimated to be up to three times the reserves.

11. Substitutes: Expanded perlite is a substitute for vermiculite in lightweight concrete and plaster. Other more dense but less costly substitutes in these applications are expanded clay, shale, slate or slag. Alternate materials for loosefill fireproofing insulation include fiberglass, perlite, and slag wool. In agriculture, substitutes include peat, perlite, sawdust, bark and other plant materials, and synthetic soil conditioners.

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YTTRIUM 1/

(Data in metric tons of yttrium oxide (Y_2O_3) content, unless noted)

1. Domestic Production and Use: Yttrium is a constituent in the domestically mined rare-earth minerals, bastnasite and monazite. Bastnasite is mined at one site in California for its rare-earth content, and small amounts of yttrium are recovered as a byproduct during processing. Monazite, recovered as a byproduct of processing heavy minerals sands for titanium and zirconium minerals by one company in Florida, is usually exported as a concentrate and its yttrium content is not recovered domestically. Most purified yttrium produced in the United States is derived from imported ores and concentrates. Three companies processed concentrates in 1985 to produce high-purity and intermediate yttrium products at plants in Arizona, Colorado, and Texas. Separated yttrium metal and compounds were consumed by 5 television phosphor producers, 3 lamp phosphor producers, 7 synthetic garnet producers, and at least 11 other companies making various products. These companies are located throughout the United States. Yttrium, which is chemically similar to the rare-earth elements and not always separated from them, is a functioning constituent of some rare-earth alloys and compounds.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production, mine and refinery	W	W	W	W	W
Imports for consumption:					
Monazite	82	79	44	62	70
Xenotime and yttrium concentrate 2/3/	W	W	W	W	W
Exports, ore and concentrate e/	6	4	3	5	9
Consumption, apparent e/4/	153	124	53	63	85
Price, dollars, yearend 1985: Monazite concentrates, 385 per ton or 35.02 per kilogram of contained yttrium oxide; yttrium concentrates (60% Y_2O_3), 51-63 per kilogram of contained yttrium oxide; xenotime (30% Y_2O_3) 31-33 per kilogram of contained yttrium oxide; yttrium oxide, 118-800 per kilogram depending on purity; yttrium metal, 510 per kilogram.					
Stocks, processor, yearend	W	W	W	W	W
Employment	Not available				
Net import reliance 5/ as a percent of apparent consumption	100	100	100	100	100

3. Recycling: None.

4. Import Sources (1981-84): Monazite--Australia 96%, Malaysia 4%, Republic of South Africa <1%.

5. Tariff:

	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Ore and concentrates	601.12 & 601.45	Free	Free	Free
Yttrium oxide	423.00	3.9% ad val.	3.7% ad val.	25.0% ad val.
Metal	632.38	3.9% ad val.	3.7% ad val.	25.0% ad val.
Alloys	632.78	34¢/lb	32¢/lb	$2/lb
Yttrium materials and compounds (yttrium concentrate)	907.51	Free	Free	25.0% ad val. or 30% ad val. 6/

6. Depletion Allowance: Monazite: 22% on thorium content and 14% on yttrium and rare earth content (Domestic), 14% (Foreign). Xenotime: 14% (Domestic and Foreign).

e/ Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.
1/ See also Rare-Earth Metals and Thorium.
2/ Xenotime, an yttrium-rare earth mineral, is chemically treated to produce yttrium concentrate.
3/ Reported by processors.
4/ Most of the consumed yttrium was imported or refined from imported ore or concentrate.
5/ Defined as imports - exports + adjustments for Government and industry stock changes.
6/ Tariff is 25% if previous import item classification was 423.00 or 423.96, part 2C, schedule 4, or 30% if 603.70, part 1, schedule 6.
7/ Includes yttrium contained in rare-earth ores.
8/ See page 182 for definitions.

Prepared by J. B. Hedrick, telephone number (202) 634-1082.

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7. Government Stockpile:

Stockpile Status--9-30-85

Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Yttrium Oxide	-	108 kg	108 kg	-

8. Events, Trends, and Issues: Yttrium was in short supply in 1985 as a result of strong demand in television phosphors, and an increase in use in lighting phosphors, electronics, and ceramic applications such as oxygen sensor and yttria-stabilized refractories. It is estimated that in 1986 domestic mine production of yttrium contained in monazite will be essentially the same as in 1985 and U.S. apparent consumption will be 90 tons (Y_2O_3 equivalent). From a 1983 base, demand for yttrium is expected to increase at an average annual rate of about 3% through 1990.

Plans to develop a large yttrium-beryllium-zirconium deposit in northeastern Quebec, Canada, were cancelled.

In a joint venture, three Canadian firms, two of which have, respectively, U.S. and Japanese parent companies with yttrium processing interests, announced plans to build a $10 million yttrium plant at the third company's existing uranium mine at Elliot Lake, Ontario, Canada. Yttrium is to be recovered as a byproduct of uranium processing. The new plant is to have an annual capacity of 150 tons of contained yttrium oxide in concentrate. The U.S. and Japanese-backed companies will reportedly each receive one-half of the plant's annual production. Final processing of the yttrium concentrates is to take place in the United States and Japan. Improved extraction technologies have reportedly made this joint venture economically feasible.

The impact of the production and use of yttrium products on the environment was generally minimal, but certain yttrium placer resources, principally monazite and xenotime, were excluded from production because of environmental considerations.

9. World Mine Production and Reserve Base:

	Mine Production e/ 7/		Reserve Base 8/
	1984	1985	
United States	W	W	47,000
Australia	184	185	5,200
Brazil	22	22	1,500
Canada	-	-	4,000
India	44	44	50,000
Malaysia	51	50	NA
Thailand	2	2	NA
Other Market Economy Countries	NA	NA	NA
Centrally Planned Economies	NA	NA	NA
World Total	NA	NA	NA

10. World Resources: Large resources of yttrium in monazite and xenotime are available worldwide in placer and beach-sand deposits. Additional large subeconomic resources of yttrium occur in other monazite-bearing deposits, apatite-magnetite rocks, sedimentary phosphate deposits, deposits of columbium-tantalum minerals, and certain uranium ores, especially those of the Blind River district, Canada. It is probable that the world's resources are very large relative to expected demand.

11. Substitutes: Substitutes are available for many applications of yttrium, but generally are much less effective. In most uses, especially in phosphors and ceramics, yttrium is not subject to substitution by other elements.

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ZINC

(Data in thousand metric tons of zinc content, unless noted)

1. Domestic Production and Use: The value of mine production in 1985, based on the price of metal, was about $200 million. The 25 leading mines accounted for 98% of mine output, with the leading five producing 56%. About 87% of the total mine output was produced in Tennessee, New York, and Missouri. Five primary and ten secondary smelters produced slab zinc. About 50% of the slab consumption was by approximately 220 firms in Illinois, Indiana, New York, Ohio, and Pennsylvania. Construction materials accounted for about 45% of consumption; transportation, 25%; machinery, 10%; electrical, 10%; and other, 10%. Of the total slab zinc consumed, galvanizing accounted for 48%; zinc-base alloys, 29%; brass and bronze, 13%; and other, 10%. About 200,000 tons of zinc in compounds and dusts were consumed mainly by the chemical, agricultural, rubber, and paint industries. Major coproducts of zinc were lead, cadmium, silver, and sulfur.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Mine, recoverable	312	303	275	253	225
Primary slab zinc	347	228	236	253	240
Secondary redistilled slab zinc	50	74	69	78	70
Imports for consumption: Ore and concentrates	246	67	63	86	70
Slab zinc, scrap, and compounds	661	498	664	694	653
Exports: Slab zinc, scrap, and compounds	33	20	24	43	43
Ore and concentrates	54	77	60	31	20
Shipments from Govt. stockpile excesses			None		
Consumption: Reported, slab zinc	841	709	306	849	800
Apparent, all forms	1,151	869	1,005	1,051	960
Price, average, cents per pound:					
U.S. High Grade metal	44.6	38.5	41.4	48.6	40.5
London, Prime Western equivalent	38.3	33.7	34.7	40.5	35.0
Stocks, yearend: Producer and consumer	127	112	113	119	118
Merchant	69	47	35	19	20
Employment: Mine and mill	4,200	3,200	2,900	2,800	2,900
Smelter e/	2,100	1,600	1,600	2,000	1,600
Net import reliance 1/ as a percent of apparent consumption	65	58	65	68	69

3. Recycling: In 1985, an estimated 75,000 tons of zinc was recovered from old scrap; an additional 300,000 tons of zinc was recovered from new scrap. Also, about 40,000 tons of zinc dust and 50,000 tons of zinc oxide was produced from zinc scrap.

4. Import Sources (1981-84): Ore, concentrates--Canada 54%, Mexico 15%, Peru 13%, Other 18%. Metal--Canada 51%, Peru 7%, Mexico 7%, Zaire 4%, Other 31%.

5. Tariff:

	Number:	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Ore and concentrate	602.20	2/0.35¢/lb	2/0.3¢/lb	1.67¢/lb
Unwrought metal	626.02	1.6% ad val.	1.5% ad val.	1.75¢/lb
Alloys	626.04	19.0% ad val.	19.0% ad val.	45.0% ad val.
Waste and scrap	626.10	2/2.5% ad val.	2/2.1% ad val.	11.0% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile:

	Stockpile Status--9-30-85			
Material	Goal	Total Inventory	Excess to Goal Authorized For Disposal	Sales, 9 Months
Zinc	1,293	343	-	-

e/ Estimated.
1/ Defined as imports - exports + adjustments for Government and industry stock changes.
2/ Duty suspended until December 1989, as provided by P.L. 98-573.
3/ World production is zinc content of concentrate and direct shipping ore.
4/ See page 182 for definitions.

Prepared by J. H. Jolly, telephone number (202) 634-1063.

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8. Events, Trends, and Issues: Zinc consumption fell in 1985 owing mainly to reduced construction and to slow growth in the U.S. economy. Zinc consumption declined in all major use categories with the galvanizing, brass, and the die casting sectors recording the largest tonnage drops. Improved economic growth, continued low interest rates, and increased zinc usage, especially for electrogalvanizing, were expected to result in a slight increase in zinc consumption in 1986. From a 1983 base, both domestic and world demand for zinc was expected to increase at an average annual rate of about 2.5% through 1990.

Domestic mine output in 1985 was the lowest since 1921. The low output was largely attributable to extended strikes at zinc mines in Tennessee and New York. Also contributing was the March closure of a zinc-producing, gold mine in Colorado. A new lead-zinc mine in Missouri opened in September, but its contribution to 1985 zinc production was relatively small. Mine production was expected to rebound in 1986 to at least the 1984 level, assuming normal production at mines struck in 1985.

Domestic metal production declined from that of 1984 owing largely to the indefinite closure in April of a 104,000-ton-per-year zinc smelter in Texas. U.S. smelter production could decline further in 1986 if the Texas plant does not reopen. Imports of slab zinc in 1985 fell from the record levels of 1984 because of lower demand; however, 1986 imports are expected to increase to near record levels in response to increased demand and decreased domestic metal production.

Zinc prices which fell sharply in the last quarter of 1984, were relatively stable in the first half of 1985, averaging about 43.8 cents per pound for High Grade zinc. In the second half of 1985, weakening world demand coupled with excessive world zinc production, resulted in sharp declines in U.S. and European zinc prices. Surprizingly low bids at the U.S. Mint's September tender for Special High Grade zinc triggered sharp downward adjustments in U.S. zinc prices after mid-September. The High Grade zinc price declined to its lowest value in the last 2 months of the year, and, for the second half, averaged about 37 cents per pound.

Environmental concerns in the zinc industry are more associated with coproduct elements such as lead, cadmium, and sulfur, than with zinc. Waste rock, effluents, gases, and fume are controlled by modern technology. At some mines, the tailings and waste rock are sold as crushed rock and agricultural limestone.

9. World Mine Production and Reserve Base:

	Mine Production 3/		Reserve Base 4/
	1984	1985 e/	
United States	278	245	53,000
Australia	634	720	49,000
Canada	1,213	1,195	56,000
Mexico	289	310	8,000
Peru	558	560	12,000
Other Market Economy Countries	1,969	2,050	90,000
Centrally Planned Economies	1,478	1,480	32,000
World Total	6,419	6,560	300,000

10. World Resources: Identified zinc resources of the world are estimated at about 1.8 billion tons. Available data on sphalerite-bearing coals in mid-continent United States indicate a resource potential of many millions of tons of zinc that could possibly be recovered as a byproduct of coal mining with limited modification of existing technology. Preliminary evaluations suggest that some coals on other continents may have similar zinc resources.

11. Substitutes: Aluminum, plastics, and magnesium are the major substitutes for die casting uses. Aluminum and plastic sheet and molded plastics substitute for galvanized sheet and formed products. Plastic coatings, paints, electroplated cadmium, and aluminum-zinc coatings can replace zinc in limited areas for corrosion protection, and aluminum alloys can be used in place of brass. Aluminum, magnesium, titanium, and zirconium are significany competitors of zinc in chemicals and pigments.

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ZIRCONIUM 1/
(Data in short tons, unless noted)

1. Domestic Production and Use: Two companies, one with a plant in Oregon and another with a plant in Utah, produced primary zirconium sponge and coproduct hafnium sponge in 1985. These firms also converted zirconium sponge to ingot. Zircon, the only significant domestic ore mineral of zirconium and hafnium, was extracted in 1985 from sand deposits, as a coproduct of ilmenite and rutile, by two firms in Florida. The value of reported consumption of zircon in 1985 was about $17.7 million. Most zircon was used in the Eastern United States; 47% was used in foundry sands, 22% in refractories, 10% in ceramics, 6% in abrasives, and 15% in miscellaneous uses, including the manufacture of chemicals and production of zirconium metal and alloys for nuclear applications and for chemical processing equipment.

2. Salient Statistics--United States:

	1981	1982	1983	1984	1985 e/
Production: Zircon	W	W	W	W	W
Zirconium metal	W	W	W	W	W
Imports for consumption:					
Zircon	2/91,108	2/68,465	2/44,487	2/66,436	70,000
Zirconium metal	513	276	383	565	500
Exports: Zircon	11,630	11,012	13,222	9,528	12,000
Zirconium, alloys, and scrap	681	878	747	808	800
Consumption: Reported, zircon 3/	150,000	93,000	100,000	130,000	140,000
Apparent, zircon	W	W	W	W	W
Price, zircon, domestic, dollars per ton, yearend	165	165	165	165	165
Stocks, zircon, consumer and dealer, yearend 4/	33,385	48,595	36,498	32,861	30,000
Employment: Mine and mill	390	325	325	375	375
Metal plant	1,500	1,800	1,750	1,800	1,800
Net import reliance 5/ as a percent of apparent consumption	W	W	W	W	W

3. Recycling: Insignificant.

4. Import Sources (1981-84): Zirconium: France 72%, Japan 8%, Canada 5%, Other 15%.
Zircon: Australia 77%, Republic of South Africa 20%, Other 3%.

5. Tariff:

	Number	Most Favored Nation (MFN) 1/1/86	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/86
Zirconium oxide	422.80	3.9% ad val.	3.7% ad val.	25.0% ad val.
Other zirconium compounds	422.82	3.9% ad val.	3.7% ad val.	25.0% ad val.
Zirconium ore & concentrate	601.63	Free	Free	Free
Unwrought zirconium, waste and scrap	629.60	4.4% ad val.	4.2% ad val.	25.0% ad val.
Unwrought zirconium alloys	629.62	5.2% ad val.	4.9% ad val.	25.0% ad val.
Wrought zirconium	629.65	5.9% ad val.	5.5% ad val.	45.0% ad val.

6. Depletion Allowance: 22% (Domestic), 14% (Foreign).

7. Government Stockpile: None.

e/ Estimated. W Withheld to avoid disclosing company proprietary data.
1/ See also Hafnium.
2/ Including baddeleyite (zirconium oxide): 1981, 1,700 tons; 1982, 500 tons; 1983, 1,000 tons; 1984, 1,200 tons.
3/ Based on incomplete reported data.
4/ Excluding foundries.
5/ Defined as imports - exports + adjustments for Government and industry stock changes.
6/ See page 182 for definitions.
7/ Excluding U.S. production.

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8. Events, Trends, and Issues: The output of zircon by U.S. producers in 1985 was approximately the same as that of 1984. The production of zirconium metal also was about the same as in 1984. Zircon imports, mostly from Australia, increased about 10% over 1984, while exports were about 20% higher than in 1984. It is estimated that in 1986 U.S. reported consumption of zircon will be 140,000 tons. The use of zircon in refractories, abrasives, and chemicals in expected to increase, as is the use of zirconium metal in refractory and corrosion-resistant alloys, but the metal's use in nuclear reactors is expected to remain about the same. From a 1983 base, demand for zirconium, in metal and nonmetal forms, is expected to increase at an average annual rate of about 4.7% through 1990.

In Australia, the construction of a pilot plant to produce high purity zirconia was announced. The plant reportedly will use a patented two-step process to convert zircon to zirconia and will be large enough to produce sufficient material to make an initial entry into the market.

A forecast published in France anticipates a resumption of nuclear electric power generating plant construction on a worldwide basis. It stated that China, Eygpt, Taiwan, Turkey, Pakistan, and India were interested in importing French designed and built reactors.

9. World Mine Production and Reserve Base:

	Mine Production		Reserve Base 6/
	1984	1985 e/	
United States	W	W	8,000,000
Australia	460,000	500,000	14,900,000
India	13,000	13,000	3,000,000
South Africa, Republic of e/	140,000	140,000	12,100,000
Other Market Economy Countries	23,920	22,000	7,000,000
China e/	16,500	16,000	1,000,000
U.S.S.R. e/	90,000	90,000	5,000,000
World Total (may be rounded)	7/743,400	7/781,000	51,000,000

10. World Resources: Resources of zircon in the United States include about 14 million tons associated with titanium resources in sand deposits, occurring mainly in the Atlantic and Gulf Coast States. Phosphate, and sand and gravel deposits may yield substantial amounts of zircon as a byproduct in the future. Identified world resources of zircon exceed 60 million tons.

11. Substitutes: Chromite, olivine, and some aluminum silicate minerals may substitute for zircon in certain foundry applications.

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RESOURCE RESERVE DEFINITIONS
(From Geological Survey Circular 831, 1980.)

Principles of a Resource/Reserve Classification for Minerals

By the U.S. BUREAU OF MINES and the U.S. GEOLOGICAL SURVEY

INTRODUCTION

Through the years, geologists, mining engineers, and others operating in the minerals field have used various terms to describe and classify mineral resources, which as defined herein include energy materials. Some of these terms have gained wide use and acceptance, although they are not always used with precisely the same meaning.

Staff members of the U.S. Bureau of Mines and the U.S. Geological Survey collect information about the quantity and quality of all mineral resources, but from different perspectives and with different purposes. In 1976, a team of staff members from both agencies developed a common classification and nomenclature, which was published as U.S. Geological Survey Bulletin 1450-A - "Principles of the Mineral Resource Classification System of the U.S. Bureau of Mines and U.S. Geological Survey." Experience with this resource classification system showed that some changes were necessary in order to make it more workable in practice and more useful in long-term planning. Therefore, representatives of the U.S. Geological Survey and the U.S. Bureau of Mines collaborated to revise Bulletin 1450-A.

Long-term public and commercial planning must be based on the probability of discovering new deposits, on developing economic extraction processes for currently unworkable deposits, and on knowing which resources are immediately available. Thus, resources must be continuously reassessed in the light of new geologic knowledge, of progress in science and technology, and of shifts in economic and political conditions. To best serve these planning needs, known resources should be classified from two standpoints: (1) purely geologic or physical/chemical characteristics - such as grade, quality, tonnage, thickness, and depth - of the material in place: and (2) profitability analyses based on costs of extracting and marketing the material in a given economy at a given time. The former constitutes important objective scientific information of the resource and a relatively unchanging foundation upon which the latter more variable economic delineation can be based.

The revised classification system, designed generally for all mineral materials, is shown graphically in figures 1 and 2 (see page 5); its components and their usage are described in the text. The classification of mineral and energy resources is necessarily arbitrary, because definitional criteria do not always coincide with natural boundaries. The system can be used to report the status of mineral and energy-fuel resources for the Nation or for specific areas.

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RESOURCE/RESERVE DEFINITIONS

A dictionary definition of resource, "something in reserve or ready if needed," has been adapted for mineral and energy resources to comprise all materials, including those only surmised to exist, that have present or anticipated future value.

Resource. - A concentration of naturally occurring solid, liquid, or gaseous material in or on the Earth's crust in such form and amount that economic extraction of a commodity from the concentration is currently or potentially feasible.

Original Resource. - The amount of a resource before production.

Identified Resources. - Resources whose location, grade, quality, and quantity are known or estimated from specific geologic evidence. *Identified resources* include economic, marginally economic, and subeconomic components. To reflect varying degrees of geologic certainty, these economic divisions can be subdivided into *measured, indicated,* and *inferred.*[1]

Demonstrated. - A term for the sum of *measured* plus *indicated.*

Measured. - Quantity is computed from dimensions revealed in outcrops, trenches, workings, or drill holes; grade and(or) quality are computed from the results of detailed sampling. The sites for inspection, sampling, and measurement are spaced so closely and the geologic character is so well defined that size, shape, depth, and mineral content of the resource are well established.

Indicated. - Quantity and grade and(or) quality are computed from information similar to that used for measured resources, but the sites for inspection, sampling, and measurement are farther apart or are otherwise less adequately spaced. The degree of assurance, although lower than that for measured resources, is high enough to assume continuity between points of observation.

Inferred. - Estimates are based on an assumed continuity beyond measured and(or) indicated resources, for which there is geologic evidence. *Inferred resources* may or may not be supported by samples or measurements.

[1]The terms "proved," "probable," and "possible", which are commonly used by industry in economic evaluations of ore or mineral fuels in specific deposits or districts, have been loosely interchanged with the terms *measured, indicated,* and *inferred.* The former terms are not a part of this classification system.

Reserve Base. – That part of an identified resource that meets specified minimum physical and chemical criteria related to current mining and production practices, including those for grade, quality, thickness, and depth. The *reserve base* is the in-place demonstrated (measured plus indicated) resource from which reserves are estimated. It may encompass those parts of the resources that have a reasonable potential for becoming economically available within planning horizons beyond those that assume proven technology and current economics. The *reserve base* includes those resources that are currently economic (*reserves*), marginally economic (*marginal reserves*), and some of those that are currently subeconomic (*subeconomic resources*). The term "geologic reserve" has been applied by others generally to the *reserve-base* category, but it also may include the *inferred-reserve-base* category; it is not a part of this classification system.

Inferred Reserve Base. – The in-place part of an identified resource from which inferred reserves are estimated. Quantitative estimates are based largely on knowledge of the geologic character of a deposit and for which there may be no samples or measurements. The estimates are based on an assumed continuity beyond the reserve base, for which there is geologic evidence.

Reserves. – That part of the reserve base which could be economically extracted or produced at the time of determination. The term *reserves* need not signify that extraction facilities are in place and operative. *Reserves* include only recoverable materials; thus, terms such as "extractable reserves" and "recoverable reserves" are redundant and are not a part of this classification system.

Marginal Reserves. – That part of the reserve base which, at the time of determination, borders on being economically producible. Its essential characteristic is economic uncertainty. Included are resources that would be producible, given postulated changes in economic or technologic factors.

Economic. – This term implies that profitable extraction or production under defined investment assumptions has been established, analytically demonstrated, or assumed with reasonable certainty.

Subeconomic Resources. – The part of identified resources that does not meet the economic criteria of reserves and marginal reserves.

Undiscovered Resources. – Resources, the existence of which are only postulated, comprising deposits that are separate from identified resources. *Undiscovered resources* may be postulated in deposits of such grade and physical location as to render them economic, marginally economic, or subeconomic. To reflect varying degrees of geologic certainty, undiscovered resources may be divided into two parts:

Hypothetical Resources. – Undiscovered resources that are similar to known mineral bodies and that may be reasonably expected to exist in the same producing district or region under analogous geologic conditions. If exploration confirms their existence and reveals enough information about their quality, grade, and quantity, they will be reclassified as identified resources.

Speculative Resources. – Undiscovered resources that may occur either in known types of deposits in favorable geologic settings where mineral discoveries have not been made, or in types of deposits as yet unrecognized for their economic potential. If exploration confirms their existence and reveals enough information about their quantity, grade, and quality, they will be reclassified as identified resources.

Restricted Resources/Reserves. – That part of any resource/reserve category that is restricted from extraction by laws or regulations. For example, *restricted reserves* meet all the requirements of reserves except that they are restricted from extraction by laws or regulations.

GUIDELINES FOR CLASSIFICATION OF MINERAL RESOURCES

1. All naturally occurring metals, nonmetals, and fossil fuels in sufficient concentration can be classified in one or more of the categories.

2. Where the term *reserves* is used alone, without a modifying adjective such as indicated, marginal, or inferred, it is to be considered synonymous with the demonstrated-economic category, as shown in figure 1.

3. Definitions of resource categories can be modified for a particular commodity in order to conform with accepted usage involving special geological and engineering characteristics. Such modified definitions for particular commodities will be given in forthcoming government publications.

4. Quantities, qualities, and grades may be expressed in different terms and units to suit different purposes, but usage must be clearly stated and defined.

5. The geographic area to which any resource/reserve estimate refers must be defined.

6. All estimates must show a date and author.

7. The *reserve base* is an encompassing resource category delineated by physical and chemical criteria. A major purpose for its recognition and appraisal is to aid in long-range public and commercial planning. For most mineral commodities, different grades and tonnages, or other appropriate resource parameters, can be specified

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for any given deposit or area, or for the Nation, depending on the specific objectives of the estimators; therefore, the position of the lower boundary of the reserve base, which extends into the subeconomic category, is variable, depending on those objectives. The intention is to define a quantity of in-place material, any part of which may become economic, depending on the extraction plans and economic assumptions finally used. When those criteria are determined, the initial reserve-base estimate will be divided into three component parts: reserves, marginal reserves, and a remnant of subeconomic resources. For the purpose of Federal commodity assessment, criteria for the reserve base will be established for each commodity.

8. *Undiscovered resources* may be divided in accordance with the definitions of *hypothetical* and *speculative resources,* or they may be divided in terms of relative probability of occurrence.

9. *Inferred reserves* and the *inferred reserve base* are postulated extensions of reserves and of the reserve base. They are identified resources quantified with a relatively low degree of certainty. Postulated quantities of resources not based on reserve/reserve-base extensions, but rather on geologic inference alone, should be classified as undiscovered.

10. Locally, limited quantities of materials may be produced, even though economic analysis has indicated that the deposit would be too thin, too low grade, or too deep to be classified as a reserve. This situation might arise when the production facilities are already established or when favorable local circumstances make it possible to produce material that elsewhere could not be extracted profitably. Where such production is taking place, the quantity of in-place material shall be included in the reserve base, and the quantity that is potentially producible shall be included as a reserve. The profitable production of such materials locally, however, should not be used as a rationale in other areas for classifying as reserves, those materials that are similar in thickness, quality, and depth.

11. Resources classified as reserves must be considered economically producible at the time of classification. Conversely, material not currently producible at a profit cannot be classified as reserves. There are situations, however, in which mining plans are being made, lands are being acquired, or mines and plants are being constructed to produce materials that do not meet economic criteria for reserve classification under current costs and prices, but would do so under reasonable future expectations. For some other materials, economic producibility is uncertain only for lack of detailed engineering assessment. The marginal-reserves category applies to both situations. When economic production appears certain for all or some of a marginal reserve, it will be reclassified as reserves.

12. Materials that are too low grade or for other reasons are not considered potentially economic, in the same sense as the defined resource, may be recognized and their magnitude estimated, but they are not classified as resources. A separate category, labeled *other occurrences,* is included in figures 1 and 2.

13. In figure 1, the boundary between *subeconomic* and *other occurrences* is limited by the concept of *current or potential feasibility of economic production,* which is required by the definition of a resource. The boundary is obviously uncertain, but limits may be specified in terms of grade, quality, thickness, depth, percent extractable, or other economic-feasibility variables.

14. Varieties of mineral or energy commodities, such as bituminous coal as distinct from lignite, may be separately quantified when they have different characteristics or uses.

15. The amount of past cumulative production is not, by definition, a part of the resource. Nevertheless, a knowledge of what has been produced is important to an understanding of current resources, in terms of both the amount of past production and the amount of residual or remaining in-place resource. A separate space for cumulative production is shown in figure 1. Residual material left in the ground during current or future extraction should be recorded in the resource category appropriate to its economic-recovery potential.

16. In classifying reserves and resources, it is necessary to recognize that some minerals derive their economic viability from their coproduct or byproduct relationships with other minerals. Such relationships must be clearly explained in footnotes or in an accompanying text.

17. Considerations other than economic and geologic, including legal, regulatory, environmental, and political, may restrict or prohibit the use of all or part of a deposit. Reserve and resource quantities known to be restricted should be recorded in the appropriate classification category; the quantity restricted and the reason for the restriction should be noted.

18. The classification system includes more divisions than will commonly be reported or for which data are available. Where appropriate, divisions may be aggregated or omitted.

19. The data upon which resource estimates are based and the methods by which they are derived are to be documented and preserved.

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RESOURCES OF (commodity name)

[A part of reserves or any resource category may be restricted from extraction by laws or regulations (see text)]

AREA: (mine, district, field, State, etc.) UNITS: (tons, barrels, ounces, etc.)

Cumulative Production	IDENTIFIED RESOURCES			UNDISCOVERED RESOURCES	
	Demonstrated		Inferred	Probability Range (or)	
	Measured	Indicated		Hypothetical	Speculative
ECONOMIC	Reserves		Inferred Reserves		
MARGINALLY ECONOMIC	Marginal Reserves		Inferred Marginal Reserves		
SUB-ECONOMIC	Demonstrated Subeconomic Resources		Inferred Subeconomic Resources		
Other Occurrences	Includes nonconventional and low-grade materials				

Author: Date:

FIGURE 1.—Major elements of mineral-resource classification, excluding *reserve base* and *inferred reserve base*.

RESOURCES OF (commodity name)

[A part of reserves or any resource category may be restricted from extraction by laws or regulations (see text)]

AREA: (mine, district, field, State, etc.) UNITS: (tons, barrels, ounces, etc.)

Cumulative Production	IDENTIFIED RESOURCES			UNDISCOVERED RESOURCES	
	Demonstrated		Inferred	Probability Range (or)	
	Measured	Indicated		Hypothetical	Speculative
ECONOMIC	Reserve		Inferred Reserve		
MARGINALLY ECONOMIC	Base		Base		
SUB-ECONOMIC					
Other Occurrences	Includes nonconventional and low-grade materials				

Author: Date:

FIGURE 2.—*Reserve base* and *inferred reserve base* classification categories.

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UNITS OF MEASURE

1 carat (diamond)	=	200 milligrams
1 flask (fl)	=	76 pounds, avoirdupois
1 karat (gold)	=	one twenty-fourth part
1 kilogram (kg)	=	2.2046 pounds, avoirdupois
1 long ton (lt)	=	2,240 pounds, avoirdupois
1 long ton unit (ltu)	=	1% of 1 long ton or 22.4 pounds, avoirdupois
long calcined ton (lct)	-	excludes water of hydration
long dry ton (ldt)	-	excludes excess free moisture
Mcf	=	1,000 cubic feet
1 metric ton (mt)	=	2,204.6 pounds, avoirdupois or 1,000 kilograms
1 pound (lb)	=	453.6 grams
1 short ton (st)	=	2,000 pounds, avoirdupois
1 short ton unit (stu)	=	1% of 1 short ton or 20 pounds, avoirdupois
1 troy ounce (tr oz)	=	1.09714 avoirdupois ounces

COUNTRY GROUPINGS

Centrally planned economy countries - Comprised of the following:

Albania
Bulgaria
China
Cuba
Czechoslovakia
German Democratic Republic
Hungary
Kampuchea
Korea, North
Laos
Mongolia
Poland
Romania
U.S.S.R.
Vietnam

TARIFF RATES

The Tokyo Round of negotiations completed in 1979 resulted in new tariff agreements with the developed nations of the world. The agreements placed most nations on a most-favored-nation (MFN) basis with generally lower rates to be phased in, or staged, over an 8-year period beginning January 1, 1980. Because of space restrictions, the only rates of the staging period that are shown under item 5 are those effective as of January 1, 1986 and January 1, 1987. During 1980, China and Tibet were included among those countries for which most-favored-nation rates apply.

The countries or areas for which non-most-favored-nation (Non-MFN) rates apply are the following:

Albania
Bulgaria
Cuba
Czechoslovakia
Estonia
German Democratic Republic and East Berlin
Indochina (any part of Cambodia, Laos, or Vietnam which may be under Communist domination or control)
Korea (any part which may be under Communist domination or control)
Kurile Islands
Latvia
Lithuania
Outer Mongolia
Poland
Southern Sakhalin
Tanna Tuva
Union of Soviet Socialist Republics and the area in East Prussia under the provisional administration of the Union of Soviet Socialist Republics

Under the Generalized System of Preferences, special tariff rates were designated for Israel, Caribbean Basin Countries, and Least Developed Developing Countries. A detailed listing of these rates appears in the Federal Register, Vol. 50, No. 172, Sept. 5, 1985, pp. 36220-36403.

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OTHER PUBLICATIONS

Additional statistical, economic, and technologic data on mineral commodities are available in other publications of the Bureau of Mines and the Geological Survey.

Bureau of Mines

Minerals Yearbook - An annual publication which reviews the mineral industry of the United States and foreign countries. Contains statistical data on metals and minerals, and their products and includes information on economic and technical trends and developments. The Yearbook is published in three volumes: Volume I, Metals and Minerals; Volume II, Area Reports, Domestic; and Volume III, Area Reports, International.

Mineral Industry Surveys - Periodic statistical and economic reports designed to provide timely statistical data on production, distribution, stocks, and consumption of significant mineral commodities. The surveys are issued monthly, quarterly, or at other regular intervals, depending on the need for current data.

Perspectives - Reports which present timely data on mineral developments in foreign geographic areas.

Mineral Commodity Profiles - Periodic reports covering a single important mineral commodity and containing both current statistical data and text covering strategic uses and industry problems.

Bulletins - Reports which describe major Bureau investigations or studies that are considered to have permanent value.

Information Circulars - Reports which primarily compile, review, abstract, and discuss various activities and developments in the mineral industries

Reports of Investigations - Describe the principal features and results of minor investigations or phases of major investigations, to keep the mineral industries and the public informed on progress in original Bureau research.

These and other Bureau reports are described in the monthly release "New Publications--Bureau of Mines," which is available free upon request from the Branch of Editorial Services, Bureau of Mines, 4900 LaSalle Road, Avondale, Md. 20782.

Geological Survey

Professional Papers - Comprehensive reports on the results of resource studies and of topographic, hydrologic, paleontologic, and geologic investigations, including longer contributions to the literature on scientific and engineering subjects.

Bulletins - Either final or progress reports on the results of resource studies and of topographic and geologic investigations; shorter contributions to economic and general geology; and descriptions of Survey instruments and techniques.

Circulars - Timely scientifically sound and accurate reports for which a simpler and less permanent format is deemed adequate. In general, the treatment of the subject is less comprehensive and final, or the report is of relative local or restricted interest, or of relatively temporary usefulness.

Maps and Charts - Numerous maps and charts pertaining to mineral resource investigations are published These include: Mineral Investigations Field Studies Maps: and Mineral Investigations Resource Maps.

These Geological Survey publications are described in the monthly release "New Publications of the Geological Survey," which is available free upon request from the Branch of Distribution, Geological Survey, 1200 South Eads Street, Arlington, Va. 22202.

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